ENVIRONMENTAL ASSESSMENT

TO ANALYZE IMPACTS OF NMFS' DETERMINATION THAT THE OZETTE LAKE SOCKEYE SALMON RESOURCE MANAGEMENT PLAN ADDRESSES SECTION 4(d) LIMIT 6 CRITERIA AND DOES NOT APPRECIABLY REDUCE THE LIKELIHOOD OF SURVIVAL AND RECOVERY OF OZETTE LAKE SOCKEYE SALMON LISTED UNDER THE ENDANGERED SPECIES ACT

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1.0 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 Description of Proposed Action and Purpose and Need

The proposed action is NMFS' evaluation and determination as to whether the Resource Management Plan (RMP) for Ozette Lake sockeye salmon *(Oncorhynchus nerka)* submitted by the Makah Tribe, and the Washington Department of Fish and Wildlife (WDFW) as the fisheries resource co-manager, described below, addresses the criteria specified in NMFS' Endangered Species Act (ESA) section 4(d) Rule Limit 6, 50 CFR 223.203 (b)(6) (4(d) Rule) and would not appreciably reduce the likelihood of survival and recovery of Ozette Lake sockeye salmon listed under the ESA. If a determination is made that the criteria are addressed, NMFS would not find it necessary or advisable to apply the take prohibitions described in section 9 of the ESA to the programs proposed in the RMP. This National Environmental Policy Act (NEPA) determination does not authorize the operation of the artificial propagation programs or facilities or the proposed research and monitoring and evaluation actions. This determination also does not authorize the fisheries referenced in the RMP or the methods by which those fisheries would be conducted.

NMFS is the Federal agency responsible for applying the ESA as it relates to listed salmon and steelhead. Actions that may affect these listed species are reviewed by NMFS through ESA section 7, section 10, or the 4(d) Rule which can be used to limit take prohibitions under section 9 of the ESA. These are the methods available under the ESA to evaluate resource management and enhancement actions. NMFS adopted the 4(d) Rule to protect and conserve threatened salmonids in innovative, efficient and cooperative ways. The Makah Tribe and WDFW have submitted their program for consideration under Limit 6 of the 4(d) Rule. Limit 6 applies to joint State/Tribal RMPs developed within the continuing jurisdiction of *United States* v. *Washington*. Therefore, the purpose and need for this action is to apply and implement 50 CFR 223.203 (b)(6) as it applies to the programs described in the co-manager's Ozette Lake sockeye salmon RMP.

The proposed resource management actions are described for NMFS' consideration in the form of a Hatchery and Genetic Management Plan (HGMP). For the purposes of this document, the Co-manager's RMP will therefore also be referred to as an HGMP.

1.2 Background

An Environmental Assessment (EA) was prepared for NMFS' 4(d) Rule including the limits for the Ozette Lake sockeye salmon Evolutionarily Significant Unit (ESU) (June 2, 2000). NMFS determined that the 4(d) Rule and its implementation would not significantly affect the quality of the human environment (NMFS 2001a). The analysis and findings in the June 2, 2000 EA and FONSI are incorporated by reference herein.

The Makah Tribe and WDFW provided an HGMP describing artificial propagation, monitoring and evaluation, and research programs proposed for implementation to assist in the recovery of the Ozette Lake Sockeye Salmon ESU (MFM 2000). Ozette Lake sockeye salmon were listed as threatened under the ESA on March 25, 1999 (64 FR 14528). The HGMP programs are proposed to occur within the geographic boundaries of the listed sockeye salmon ESU (Figure 1).

Using the definitions found in Washington Place Names[1] for the purpose of this document, areas encompassed within the Ozette Lake sockeye salmon ESU will be referred to as Ozette Lake, Ozette River, and Ozette Lake tributaries accessible to anadromous salmon, including Umbrella Creek, Big River, and Crooked Creek.

The Makah Tribe has operated a sockeye salmon hatchery on a tributary to Umbrella Creek, an Ozette Lake tributary, since 1982. Operation of the Umbrella Creek Hatchery has been funded in part by the Bureau of Indian Affairs (BIA). Additional funds for the program have been provided by the Makah Tribe, and from grants awarded under various State and Federal programs. The hatchery operates on private land leased by the Tribe. Since its inception, the Umbrella Creek Hatchery has been devoted to integrated recovery of the natural population of sockeye salmon in the Ozette watershed. In past years, broodstock used for the program were collected from adult sockeye salmon aggregations spawning naturally on the shores of Ozette Lake. Eggs were incubated and alevins and fry were reared at the hatchery. Alevins and fry were subsequently released into Umbrella Creek, Ozette Lake, and other tributaries. Since 2000, broodstock have been collected from natural- and hatchery-origin adult sockeye salmon returning to Umbrella Creek.

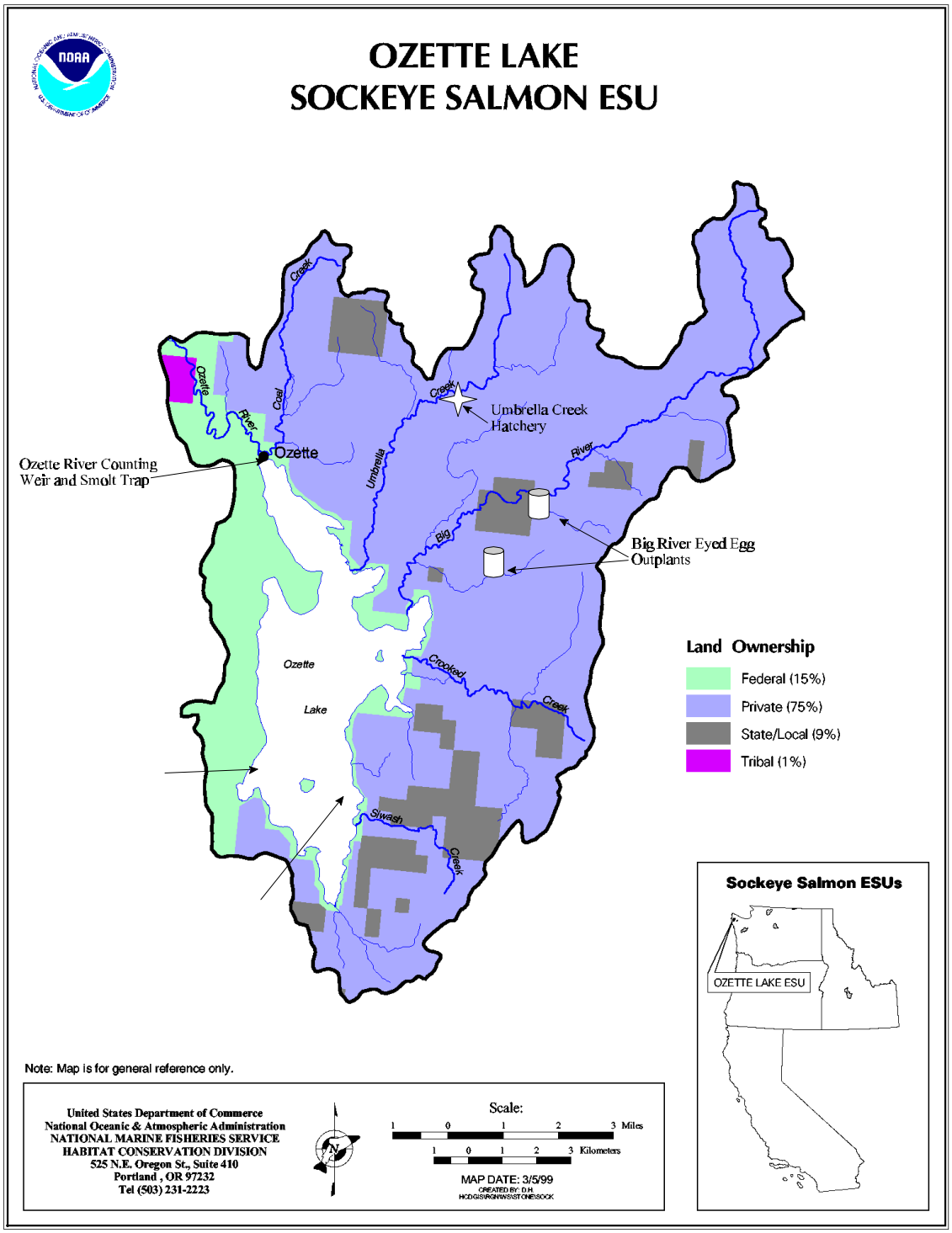
In its review of sockeye salmon population status in the Pacific Northwest (Gustafson *et al.* 1997), NMFS compiled all available information on the biology and ecology of Ozette Lake sockeye, and examined recovery options in considerable detail. Following the listing of Ozette Lake sockeye salmon, the Makah Tribe and BIA incorporated NMFS' findings, and the results of research conducted by the Makah Tribe over the past 25 years in the Ozette Basin, into the Ozette Lake Sockeye HGMP. This HGMP includes all of the Makah Tribe's on-going and proposed hatchery, research, and monitoring and evaluation programs in the Basin. The Tribe and BIA developed the HGMP with assistance from, and in close coordination with, NMFS, the U.S. Fish and Wildlife Service (USFWS), and WDFW.

To further refine sockeye salmon production and population monitoring plans proposed in the HGMP, and to identify and address potential environmental consequences, the draft HGMP was circulated for review by resource management agencies in 2000 and 2001. The draft HGMP was reviewed by the National Park Service (NPS), WDFW, USFWS, and other interested parties. Further modifications to the HGMP were made in response to comments received through these reviews, and a final HGMP was submitted to NMFS in April 2001. The HGMP documents the

[1] Washington Place Names accessed at http://www.tpl.lib.wa.us/v2/nwroom/wanames.htm (January 18, 2002).

comprehensive review of alternative actions that led to completion of the final version, and its review of alternatives is incorporated by reference in this EA. The HGMP also served as a biological assessment prepared by the BIA to initiate consultation under section 7 of the ESA.

Figure 1. Location and geographic boundaries of the Ozette Lake Sockeye Salmon ESU.



The proposed HGMP covers sockeye salmon artificial propagation, research, and monitoring and evaluation programs in the Ozette Lake Basin that are managed by the Makah Tribe and funded by BIA. WDFW is directly involved in the overall management of the programs as co-manager, with the Makah Tribe, of the fisheries resource in the Ozette Lake Basin under the *United States* v *Washington* (1974) management framework. The actions proposed in the HGMP are designed to increase the abundance, productivity, spatial structure, and diversity of listed sockeye salmon to benefit their survival and recovery. Monitoring and evaluation actions are included to determine the success of the artificial propagation program, and its potential effects on listed naturally spawning fish. Research actions are also proposed to increase scientific understanding regarding sockeye salmon abundance status, factors limiting the productivity of the sockeye salmon ESU, and life history characteristics of the listed sockeye population.

The Tribe has requested that NMFS approve the HGMP pursuant to 50 CFR § 223.203(b)(6) and thereby grant the Tribe's hatchery supplementation program an exemption from the take prohibition of section 9(a)(1) of the ESA, 16 USC § 1538(a)(1). The BIA has also requested consultation with NMFS pursuant to section 7(a)(2) over the BIA's funding of the Tribe's hatchery supplementation program under the HGMP (Speaks 2000). As noted above, the HGMP includes a biological assessment prepared by the BIA under section 7(c) of the ESA. NMFS has prepared a draft section 7 biological opinion as part of this consultation, as well as consultation on potential effects on essential fish habitat pursuant to the Magnuson-Stevens Act. Based on an evaluation of the artificial propagation and other actions implemented through the HGMP in NMFS' ESA 4(d) Rule evaluation and recommended determination document (NMFS 2001), NMFS has preliminarily concluded in its opinion that BIA's funding of the HGMP is not likely to jeopardize the continued existence of Ozette Lake sockeye salmon[2]. NMFS determined that adequate measures would be implemented to minimize the effects of any take. Benefits to the preservation and recovery of the ESU resulting from implementation of the HGMP were determined to outweigh potential negative impacts associated with the HGMP.

The Tribe intends that hatchery supplementation will be part of a comprehensive recovery plan for sockeye salmon populations in the Ozette Lake Basin. The goal of the recovery plan will be to restore properly-functioning habitat conditions and an abundant, productive, diverse, and self-sustaining sockeye salmon population. The recovery plan is currently being developed under the auspices of the Ozette Lake Sockeye Steering Committee, which includes the Makah Tribe, NMFS, USFWS, WDFW, NPS, Clallam County, and the Quileute Tribe.

[2] A federal court recently vacated the formal rule designating critical habitat for the Ozette Lake sockeye ESU. However, the analysis and conclusions regarding effects on habitat remain informative for NMFS' application of the jeopardy standard. Also, if critical habitat is re-designated before this action is fully implemented, the analysis will be relevant when determining whether a reinitiation of consultation will be necessary at that time.

1.3 Applicable Law

The Federal action evaluated in this EA – NMFS' determination of whether the co-managers' RMP addresses Limit 6 4(d) Rule criteria and qualifies for limits on ESA take prohibitions – is affected by several applicable laws. These laws are in addition to NEPA evaluation requirements that are the subject of this EA. These other guiding laws, summarized below, are: Federal Treaties that secure Tribal rights for taking fish at usual and accustomed areas; Federal stewardship responsibilities to Tribes defined by the U.S. Supreme Court and in U.S. Governmental Orders; and listed species impact review, jeopardy determination, and protection requirements of the ESA.

1.3.1 The Treaty of Neah Bay

In 1855, the United States entered into the Treaty of Neah Bay with the Makah Tribe. Article 4 of this Treaty secures the Tribe's right of taking fish at usual and accustomed grounds and stations in common with all citizens of the United States. Ozette Lake was found to be a usual and accustomed fishing area for the Makah Tribe in *United States* v. *Washington*, 384 F. Supp. 312, 364 (W.D. Wash. 1974).

At the time that the Treaty was signed, sockeye salmon and other anadromous fish species originating in the Ozette Lake watershed were plentiful, providing an important source of food and, as trade commodities, commerce for the Makah Tribe. However, the decline in Ozette Lake sockeye salmon abundance over the past century has prevented the Tribe from conducting any Treaty-reserved sockeye salmon fisheries in the Ozette Lake Basin for almost 20 years. No Tribal commercial sockeye salmon fisheries have occurred in the watershed for at least 35 years. The Makah Tribe intends to rebuild the Ozette Lake sockeye salmon resource to the point where it will again be possible to conduct meaningful, ceremonial, subsistence, and commercial Treaty fisheries in the Ozette Lake Basin.

1.3.2 The Federal Trust Responsibility

Under the Federal trust responsibility, Federal agencies, including NMFS, have a legal obligation to support the Makah Tribe in efforts to preserve and rebuild Treaty salmon fisheries in the Tribe's usual and accustomed fishing area. The concept of "trust responsibility" is derived from the special relationship between the Federal Government and Indians, first delineated by Supreme Court Chief Justice John Marshall in *Cherokee Nation* v. *Georgia*, 30 U.S. 1 (5 Pet.) (1831). Later, in *Seminole Nation* v. *United States*, 316 U.S. 286 (1942), the Court noted that the United States "has charged itself with moral obligations of the highest responsibility and trust" toward Indian Tribes. The scope of the Federal trust relationship is broad and incumbent upon all Federal agencies. The U.S. Government has an obligation to protect Tribal land, assets, and resources, as well as a duty to carry out the mandates of Federal law with respect to American Indian and Alaska Native Tribes. This unique relationship provides the Constitutional basis for legislation,

Treaties, and Executive Orders that grant unique rights or privileges to Native Americans to protect their property and their way of life.

In furtherance of this trust responsibility, and to demonstrate respect for sovereign Tribal governments, the principles described above were incorporated into Secretarial Order No. 3206, dated June 5, 1997, and signed by the Secretaries of Commerce and Interior. This Order, "American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act," directs both Departments to carry out their responsibilities under the ESA in a manner that harmonizes the Federal trust responsibility with Tribes, Tribal sovereignty, and statutory missions of the Departments, so as to avoid or minimize the potential for conflict and confrontation.

On May 14, 1998, President Clinton issued Executive Order (EO) 13084, "Consultation and Coordination with Indian Tribal Governments," requiring each Federal agency to establish meaningful consultation and collaboration with Indian Tribal governments in formulating policies that significantly or uniquely affect their communities. The order requires agency policy-making to be guided by principles of respect for Tribal Treaty rights and responsibilities that arise from the unique legal relationship between the Federal Government and Indian Tribal governments. Furthermore, on issues relating to Treaty rights, EO 13084 directs each agency to explore, and, where appropriate, use consensual mechanisms for developing regulations.

On November 6, 2000, President Clinton signed EO 13175, which replaced EO 13084. The order carries the same title and strengthens the government-to-government relationship between the United States and Indian Tribes. It ensures that all Executive departments and agencies consult with Indian Tribes and respect Tribal sovereignty as they develop policy on issues that impact Indian communities.

1.3.3 The Endangered Species Act

The Endangered Species Act (ESA) was adopted by Congress to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved and to provide a program for the conservation of such species (16 USC § 1531(b)). The ESA establishes a policy requiring all Federal departments and agencies to seek to conserve endangered and threatened species and to utilize their authorities in furtherance of the purposes of the Act. The ESA defines "conserve" as "to use or the use of all methods and procedures which are necessary" to bring any endangered or threatened species to the point where the protections of the Act are no longer necessary.

Under section 7 of the ESA, all Federal agencies have a duty to insure that any actions they authorize, fund, or carry out, are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of any critical habitat. With respect to Ozette Lake sockeye salmon, agencies must fulfill their duties under section 7 through consultation with NMFS. Consultation is complete when NMFS issues a

biological opinion setting forth its determination about whether a proposed action is likely to jeopardize the continued existence of a listed species. As noted above, the BIA has prepared a biological assessment under section 7(c) of the ESA, and has requested consultation with NMFS over its funding of the Makah Tribe's hatchery supplementation program and the Tribe's implementation of the Ozette Lake Sockeye HGMP.

Section 9(a)(1) of the ESA prohibits any person from "taking" any endangered species. The section 9(a)(1) prohibitions on take have been extended to threatened Ozette Lake sockeye salmon and other threatened species of anadromous fish by rules adopted by NMFS under section 4(d) of the ESA (65 FR 42422, July 10, 2000). However, the section 4(d) Rule adopted by NMFS limits the application of take prohibitions for activities associated with artificial propagation programs, provided that a State or Federal HGMP has been approved by NMFS as addressing a series of conservation criteria specified in the rule. As noted above, the BIA, in cooperation with the Makah Tribe, submitted the Ozette Lake Sockeye HGMP to NMFS for approval under the 4(d) Rule provisions.

1.3.4 Federal Approvals Necessary to Implement the Proposed Action

In addition to the NEPA review and evaluation requirements for NMFS' 4(d) Rule determination, the HGMP that is the subject of the determination is being reviewed through two other Federal environmental impact assessment processes. As noted above, NMFS must decide whether the HGMP prepared by the co-managers for managing future operations of the Tribe's hatchery, research, and monitoring and evaluation programs addresses Limit 6 4(d) Rule criteria, thereby qualifying for limits on ESA take prohibitions under the Rule. Because the BIA provides Federal funding to the Makah Tribe for implementation of the HGMP, the BIA and the Makah Tribe are also subject to the consultation requirements of section 7 of the ESA. NMFS is completing a biological opinion as part of this consultation to determine whether BIA's funding action jeopardizes the continued existence of the listed sockeye salmon ESU, and whether the action destroys or adversely modifies the species' designated critical habitat. A Magnuson-Stevens Act (MSA) Essential Fish Habitat (EFH) consultation must also be completed for the Federal HGMP funding action. The MSA and its implementing regulations at 50 CFR 600.920 require a Federal agency to consult with NMFS before it authorizes, funds or carries out any action that may adversely affect EFH. Section 3 of the MSA defines EFH as, "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." NMFS interprets EFH to include aquatic areas and their associated physical, chemical and biological properties used by fish that are necessary to support a sustainable fishery and the contribution of the managed species to a healthy ecosystem.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

Two alternatives were identified and considered in this EA: under Alternative 1 (No Action) NMFS would determine that the RMP does not address the criteria in the 4(d) Rule Limit 6. Under Alternative 2 (Proposed Action) NMFS would determine that the RMP does address the 4(d) Rule Limit 6 criteria.

2.1 Alternative 1 (No Action)

This alternative represents the No Action alternative. Under this alternative, NMFS would determine that the RMP does not address the 4(d) Rule Limit 6 criteria and therefore the RMP would not likely be implemented. ESA section 9(a) prohibitions would apply to activities carried out as described in the RMP, and no limits on application of these prohibitions would be approved under the 4(d) Rule. As one outcome of this alternative, the Makah Tribe and WDFW could potentially terminate the proposed hatchery and associated research and monitoring and evaluation actions to avoid violating the 4(d) Rule for Ozette Lake sockeye salmon.

An alternative potential outcome of the No Action alternative is that the co-managers could seek NMFS' approval for the actions proposed in the RMP through other listed species impact review and take authorization mechanisms afforded under the ESA. Section 10(a)(1)(A) of the ESA allows parties whose activities may result in the direct take of a listed species (in this case, listed sockeye salmon that would be affected by the proposed HGMP programs) to obtain a take permit for enhancement and research actions. Section 7 incidental take statements (Federal programs) or section 10(a)(1)(B) permits (non-Federal programs) can authorize take that is an incidental result of (rather than the purpose of) conducting the HGMP programs. If a section 10 permit is issued, and/or if a section 7 consultation is completed, take may be authorized, potentially with conditions, for the proposed hatchery, research, and monitoring and evaluation actions.

This latter outcome is unlikely, as, based on the Treaty Tribes' interpretation of Federal trust responsibilities detailed in the U.S. Government and Court Orders, and the special government to government relationship shared by the U.S. Government and the Tribes, it is their opinion that direct take permit authorization requirements specified in section 10 of the ESA do not apply to their resource management actions. It is therefore unlikely that the Makah Tribe, and as co-manager, WDFW, would apply for any section 10 permits to receive authorization for those artificial propagation and research and monitoring and evaluation facets of the proposed programs that may be defined as direct take actions. It is therefore expected that the more likely outcome of the application of this alternative is that the co-managers would curtail the proposed hatchery, research, and monitoring and evaluation programs.

2.2 Alternative 2 (Proposed Action)

The Proposed Action is NMFS' determination that the RMP addresses the criteria in the 4(d) Rule Limit 6. The outcome of this determination would be that limits on ESA section 9 take prohibitions do not apply to actions undertaken in compliance with the RMP developed jointly by the co-managers. In making its 4(d) Rule determination, NMFS evaluates the following RMP activities proposed by the Makah Tribe and WDFW, together with all of the implementation measures.

Below are descriptions of the artificial propagation, research, and monitoring and evaluation activities proposed within the co-manager's RMP. Descriptions of these activities are summarized from information presented in the Ozette Lake sockeye salmon HGMP (MFM 2000). The described activities are proposed in areas where listed sockeye salmon are known to occur. The potential effects of the HGMP on listed sockeye salmon would be associated primarily with: capture through broodstock collection in the tributaries; capture, handling, and release during weir and trap operations; and incidental effects potentially resulting from hatchery-origin sockeye salmon juvenile releases (ecological effects) and from hatchery-origin adult fish straying and/or listed sockeye propagation in the hatchery (genetic effects).

Artificial Propagation

The artificial propagation program proposed in the HGMP is designed to test whether sockeye salmon can be established in Ozette Lake tributary spawning habitat that may have been used historically for sockeye salmon production. Successful establishment of self-sustaining tributary spawning sockeye salmon aggregations through the program would increase the abundance of natural-origin, listed fish in the ESU. Facilities used in the program include the U.S. Fish and Wildlife Service's Makah National Fish Hatchery or the Makah Tribe's Educket Hatchery for egg fertilization and incubation, and Makah Tribal hatchery facilities on two Ozette Lake tributaries (Umbrella Creek and Big River) for sockeye salmon trapping, spawning, egg hatching, juvenile fish rearing, and fish release. The expected duration of the tributary hatchery program is 12 years, or three sockeye salmon generations, per release site. The hatchery portion of the program would conclude in 2012, if re-establishment of each of the four year sockeye salmon classes required to provide viable, naturally-spawning, fully-seeded aggregations in the release areas has occurred. Certain elements of the proposed hatchery actions may be modified upon 12 year review if deemed beneficial to complete re-establishment of the four year classes. Similarly, research and monitoring and evaluation actions may be continued after the 12 year review if deemed necessary for recovery of the ESU. The co-managers' overall goals and objectives for the program would also be reevaluated over the duration of the hatchery programs to incorporate new findings. Annual reporting of monitoring and evaluation results for the hatchery programs would occur. Each year's results would be discussed with NMFS during conferences included as implementation measures within NMFS' 4(d) Rule determination for the Ozette Lake sockeye salmon HGMP. Results would be applied to adaptively manage the hatchery program to improve its performance, if necessary.

The proposed program isolates tributary artificial propagation efforts and effects from the core, listed beach spawning sockeye salmon aggregations. The tributary hatchery program relies on broodstock removed from Ozette Lake sockeye salmon returns to Umbrella Creek, a northern tributary to Ozette Lake. Juvenile fish produced through the program are imprinted and released into the creek. Adult sockeye salmon returns to the tributary originate from past hatchery juvenile fish releases. Although originally used as the donor to found the tributary returns, the listed Ozette Lake beach-spawning aggregation would not be used as broodstock. Sufficient sockeye adult returns are now returning to Umbrella Creek to sustain the tributary hatchery program. Adult sockeye salmon returns to the creek include direct hatchery-origin fish ("F1" fish), and natural-origin sockeye salmon that are progeny of hatchery-origin adults that have spawned naturally in the tributary in previous years. Natural-origin sockeye salmon produced as a result of the tributary hatchery program are listed under the ESA.

Up to 200 sockeye salmon adults would be collected each year from Umbrella Creek using a temporary weir and trap to produce approximately 80,000 unfed and fed sockeye juveniles for release into Umbrella Creek. The carcasses of sockeye salmon adults spawned through the program would be returned to the stream for ecosystem nutrient enrichment purposes. Deposition of the salmon carcasses meets the objective of contributing ocean-origin nutrients that they carry to the enhancement of terrestrial and aquatic life in the Ozette Lake ecosystem, including sockeye salmon (Schmidt *et al.* 1998) and organisms that natural-origin juvenile salmon feed upon during rearing. An additional 139,000 eyed eggs taken from Umbrella Creek broodstock would be incubated in temporary hatchery facilities located on Big River, an adjacent Ozette Lake tributary. Assuming an average eyed egg to juvenile fish survival rate of 97%, the program on Big River would lead to the release of 133,000 unfed and fed sockeye salmon juveniles. Juvenile sockeye released at both sites would emigrate to Ozette Lake, where they would rear in the natural environment for one year before emigrating seaward as smolts.

Based on an estimated fry to returning adult survival rate of 0.6%, the co-managers estimate that, beginning in 2004, 480 adult sockeye salmon may return to Umbrella Creek and 798 adult sockeye salmon may return to Big River each year as a direct result of the tributary hatchery program (MFM 2000). Additional natural-origin recruit adult fish would return to the tributaries concurrently with the "F1" hatchery-origin adult sockeye salmon. The risk of fish disease transmission from hatchery-origin fish to listed natural-origin sockeye salmon is minimized through compliance with "Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" and Pacific Northwest Fish Health Protection Committee protocols (NWIFC and WDFW 1998; PNFHPC 1989).

Research and Monitoring and Evaluation

The HGMP includes research programs designed to improve scientific understanding of the status of the listed sockeye salmon population, sockeye salmon life history characteristics, and factors limiting sockeye salmons productivity. Research actions proposed to be conducted through implementation of the HGMP that should benefit lake spawning population recovery efforts are:

1) harbor seal and river otter predation studies to determine effects on adult sockeye salmon in the Ozette Lake Basin (radio tagging and predation observation research);
2) annual enumeration, and identification of hatchery versus natural-origin return proportions, of sockeye salmon adults arriving at the Ozette River fish counting weir;
3) annual estimation, by hatchery and natural-origin, of sockeye salmon smolt emigration levels at the Ozette River juvenile out-migrant trap;
3) egg and fry survival and predation loss rate studies on lake beaches;
4) habitat surveys to identify the location and condition of extant beach spawning areas in Ozette Lake; and
5) spawning ground surveys to enumerate sockeye salmon spawning abundances in beach and tributary areas.

The core, listed beach-spawning population is proposed to be collected in low numbers for research purposes. Alternatively, tributary-origin sockeye salmon may supplant listed adult fish as broodstock for this research. If used, artificial propagation of beach spawning fish would be limited to the annual capture and spawning of 10 adults, or 0.7% of the recent year average beach spawning sockeye return. Eggs spawned from these adults are proposed to be incubated to the eyed life stage at Makah National Fish Hatchery, then outplanted for egg and fry survival studies on Ozette Lake spawning beaches where the fish were collected. If tributary-origin sockeye salmon eggs are used for this study, all fish would be retained in incubators deployed on the beaches and none of the resultant progeny would be released at the study sites. This research would help identify sockeye salmon limiting factors, genetic composition, and life history strategies.

Monitoring and evaluation is included in the HGMP to determine the success of the tributary hatchery program in meeting its objectives of creating self-sustaining tributary spawning sockeye salmon aggregations. Monitoring and evaluation is also proposed to determine the effects of the tributary hatchery program on the listed beach spawning sockeye salmon population. Monitoring and evaluation actions proposed in the HGMP are:

1) identification, through hatchery fish mass marking and mark observation/recovery programs, of the proportions of hatchery and natural-origin adult sockeye salmon entering the lake and spawning in natural spawning areas, including beaches;
2) monitoring of ecological interactions between hatchery-origin sockeye salmon and natural-origin sockeye salmon;
3) monitoring through radio tagging and hydroacoustic surveys, of adult sockeye behavior during migration and spawning, and identification of the locations of spawning in Ozette Lake;
4) identification of the genetic characteristics of lake and tributary sockeye populations and of Ozette Lake kokanee populations; and
5) monitoring of the number and emigration behavior of sockeye salmon smolts in the Ozette River.

3.0 AFFECTED ENVIRONMENT

3.1 Physical Environment

Following is a description of the physical environment within the range of the Ozette Lake sockeye salmon ESU. The range (Figure 1) generally includes Ozette Lake, and all streams and rivers accessible to anadromous salmon within the Ozette Lake Basin, including the Ozette River. Components of these freshwater areas that are essential to the survival of the ESU are lake, stream and river areas used by sockeye salmon for migration, spawning, and egg and fry development, and adjacent riparian and forest habitat that helps sustain lake, stream, or river environmental and productivity conditions. The range also includes nearshore estuarine and marine areas used by sockeye salmon on the Washington coast for juvenile emigration, early rearing, and returning adult migration.

Ozette Lake is a large (2,954 hectare) lake with a mean depth of 40 m and a maximum depth of 96 m (Bortleson and Dion 1979). The lake is near the northwest tip of the Olympic Peninsula in Olympic National Park, Washington. The lake thermally stratifies during May through October, and near-surface temperatures average 21°C during summer. Water level fluctuates 2.7 m during the year. The lake is fed by numerous small tributaries and is drained by the Ozette River, which flows 7.8 km to the Pacific Ocean (Dlugokenski *et al.* 1981). The Makah Tribe's Ozette Reservation bounds the Ozette River for a small distance near the mouth. Tributaries in the Ozette Lake Basin, including Umbrella Creek, Big River, Coal Creek, and Crooked Creek, have low gradients and are small, relying predominately on rain-fall as a water source. The Olympic Peninsula receives 160 to 380 cm of precipitation per year, and the lowest annual sunshine (averaging less than 1,800 hours/year) of anywhere in the continental United States (Gustafson *et al.* 1997).

Water quality in the lake, and its moderate productivity status, are affected by dissolved and particulate sources, including the contribution of organic and inorganic matter borne by its tributaries. The type and quantity of inorganic matter input to the lake by its tributaries are affected by the natural geologic characteristics of the Basin. The area west of Lake Ozette is underlain by glacial drift; sand, silt, and clay are of Pleistocene age (Dlugokenski *et al.* 1978). Eastern portions of the Basin, with the exception of the headwaters of Umbrella Creek and Big River in the northeast, are underlain by terrace deposits; fluvial and glaciofluvial sand and gravel are of Pliocene and Pleistocene age. The headwater areas of Umbrella Creek and Big River are underlain by marine and non-marine sandstone and siltstone of Tertiary age (Dlugokenski *et al.* 1978). Recent data collected by the Makah Tribe indicates high levels of fine sediment (<0.85 mm) within spawning gravels of Ozette Lake tributaries, averaging 17.1% of core samples (Makah Fish Management (MFM), unpublished data). The lake is located within Olympic National Park, and development of Basin resources for residential and commercial uses is therefore relatively low. However, Ozette Lake is used by local residents and the National Park Service as a domestic water source (Dlugokenski *et al.* 1978).

Anadromous salmon returning from ocean areas and spawning in the Basin are an important allochthonous source of organic and inorganic nutrients affecting water quality. This ocean-origin source of nutrient input is considered beneficial to the ecosystem (Cedarholm *et al.* 2000). The historical amounts of nutrients available to the Ozette Lake ecosystem from salmon carcasses was likely large, and contributed to the enhancement of many forms of aquatic life, including the organisms that natural-origin juvenile salmon feed upon during rearing (MFM 2000). The present level of contribution of ocean-derived nutrients by salmon varies, and is dependent on the annual abundance status of spawning populations.

In addition to their effects on water quality, spawning salmon may also modify the physical characteristics of spawning areas. In a study of stream-bed scour, egg burial depths, and the influence of salmonid spawning on stream-bed surface mobility and salmon embryo survival, Montgomery *et al.* (1996) reported that salmon spawning activity may reduce fine sediment concentrations in spawning gravels and change stream-bed contour, reducing bedload movement within spawning areas. The effects of salmon spawning on the existing physical characteristics of Ozette Lake and tributary bedlands are unknown, but are likely reduced from historical levels given depressed salmon abundance levels in recent years.

Private timber corporations own the majority of the Ozette Lake watershed (Dlugokenski *et al.* 1981; Figure 1). In the last century, the entire Ozette Lake watershed has been converted from old growth, coastal temperate rainforest to timber production in 35 to 50 year rotations. Historically, riparian areas within the Basin were dominated by old growth Sitka spruce, Douglas fir, western hemlock, and western red cedar stands. Nearly all of these riparian stands have been clear-cut logged, and are currently in early stages of succession. Larger Ozette Lake tributaries are now dominated by extensive stands of red alder. Logging road densities within the Ozette lake Basin are approximately 2.2 km/km2 (McHenry *et al.* 1994). Extensive timber harvesting and logging road construction has led to hill slope and stream bank erosion and increased stream sedimentation (Dlugokenski *et al.* 1981). Stream-beds in Ozette Lake tributaries are characterized by high levels (17.1% average) of fine sediment (<0.85 mm) (McHenry *et al.* 1994; MFM 2000). Sediments smaller than 0.85 mm in concentrations greater than 11% (by volume) have been found to decrease survival of salmonid eggs and alevins within gravels (Peterson *et al.* 1992). McHenry *et al.* (1994) found that fine sediments (<0.85 mm) at concentrations >13% resulted in intragravel mortality of salmonid embryos due to oxygen stress and metabolic waste build-up. The natural sandstone and shale geomorphological character of the Ozette Lake watershed may also be a causative factor for high sediment loads in Basin streams.

Concurrent with clear-cut logging in the drainage in the early 1950s, large woody debris was removed by the Washington Department of Fisheries from the Ozette River. Logjam removal documented in the 1950s began in August of 1952, and required 63 days to complete (Kramer 1953). Kramer reported 26 separate log concentrations creating passage problems for fish, some of which contained trees six to eight feet in diameter. Dlugokenski *et al.* (1981) reported that prior to its inclusion under Olympic National Park management, the Ozette River was maintained free of log jams, presumably by local citizens with assistance from resource management agencies.

Logjam removal resulted in changes in river morphology, which may have impacted river and lake hydrological processes and habitat conditions (MFM 2000). Logjam removal may have altered the hydrology of both the Big and Ozette rivers by increasing channel efficiency and decreasing storage capacity, resulting in increased peak flows (MFM 2000).

3.2 Biological Environment

The biological environment potentially affected by the HGMP includes Ozette Lake, Ozette River, two tributaries to Ozette Lake (Umbrella Creek and Big River) and adjacent, nearshore marine waters of the Washington coast. Biological resources outside of these areas are not likely to be affected. The status of listed and unlisted salmonid species is discussed, as well as the status of other fishes, and other affected organisms in the Basin.

3.2.1 Fish Species Listed Under the ESA

The Federal ESA provides for the conservation of endangered and threatened species of fish, wildlife, and plants. The program is administered jointly by the Department of Commerce (through NMFS) for most marine and anadromous species and the Department of Interior (through USFWS) for terrestrial species, for some marine and for all freshwater resident species.

Ozette Lake Sockeye Salmon (Oncorhynchus nerka)
The Ozette Lake sockeye salmon ESU was listed as threatened under the ESA on March 25, 1999 (64 FR 14528). In making this determination, NMFS concluded that the ESU was likely to become endangered in the foreseeable future if present conditions continue. NMFS also concluded that current protective efforts were insufficient to forestall the risk of extinction. The listed sockeye salmon ESU includes all naturally spawned sockeye salmon residing below impassable natural barriers (e.g., long-standing, natural waterfalls) in Ozette Lake and its tributaries. Sockeye salmon stock reared at the Makah Tribe's Umbrella Creek Hatchery were considered part of the ESU, but were not considered essential for recovery of the ESU. NMFS determined that it is presently not necessary to consider the progeny of intentional hatchery-wild or wild-wild crosses produced through the Makah Tribal hatchery program as listed under the ESA (64 FR 14528, March 25, 1999). However, once the hatchery fish return and spawn in the wild, their progeny become listed.

Sockeye salmon in the Ozette Lake Basin comprise a unique ESU and are genetically distinct from all other sockeye populations on the Washington coast and in Puget Sound. Mature adults return to freshwater during an extended period from spring through late summer, and spawn at two primary locations along eastern and western lakeshore areas at the southern end of the lake, and in Umbrella Creek and Big River. Post-emergent fry rear in the lake for a year before undergoing smoltification. The lake is highly productive and out-migrant yearling smolts are unusually large, averaging 120 mm fork length (the length of the fish from the tip of its snout to the furthest point on the fork of the tail) and exceeding 14 grams in weight (Jacobs *et al.* 1996; Dlugokenski *et al.* 1981). Smolts produced in Ozette lake are documented as the third largest

among west coast sockeye populations examined for average smolt size (Dlugokenski *et al.* 1981). Ozette Lake sockeye smolts were found to be more than double the average weight of other sockeye salmon smolts measured in 34 lake systems by Burgner (1987).

Adults of this stock return to Ozette Lake in the late spring and early summer months predominantly as four-year-old individuals, as determined by scale analysis. However, three- or five-year-old adult fish are occasionally observed in the return. The most recent scale analyses conducted by WDFW on 1998 broodstock revealed that 71/71 (100%) were four-year-old fish (MFM 2000). Another recent scale analysis conducted in conjunction with a 1994 genetic stock identification study identified 80 of 81 samples as four-year-olds, and one as a five-year-old.

Adult sockeye salmon hold in Ozette Lake up to six months prior to spawning. The two principle shoreline spawning areas for Ozette Lake sockeye are Olsen's Beach, located on the lake's eastern shore north of Siwash Creek, and Allen's Bay Beach, located on the lake's western shore (MFM 2000; Jacobs *et al.* 1996; Figure 1). Mature adult sockeye salmon in Ozette Lake have also been reported near the south shore of Baby Island at the southern end of the lake, in Erickson's Bay (Gustafson *et al.* 1997), and on the beach north of Umbrella Creek (WDF and WWTIT 1994; Jacobs *et al.* 1996). Historically, it is likely that sockeye salmon also spawned in tributaries to Ozette Lake, potentially including Big River, Umbrella Creek, and Crooked Creek, and in the Ozette River (WDF and WWTIT 1994; Jacobs *et al.* 1996; Dlugokenski *et al.* 1981).

The majority of spawners at both lake beaches and in the tributaries begin spawning by late-October to early-November and complete spawning by late-November to early-December, annually. In return year 2000-2001, spawning was observed through January 22 on Allen's Beach, and through January 31 on Olsen's Beach. Dlugokenski *et al.* (1981) reported relatively large numbers of spawners on Allen's Beach in January of 1979, with considerable numbers spawning into February of 1979. However, peak spawning on Allen's Beach, like Olsen's Beach, has occurred prior to January in recent years (1998 to 2001) (MFM 2000).

The historical abundance of Ozette Lake sockeye salmon is poorly documented. However, the overall abundance of naturally-produced Ozette Lake sockeye salmon is believed to have declined substantially from historical levels. In the first study of lake escapement of Ozette Lake sockeye salmon (Kemmerich 1945), the run size entering the lake was estimated at a level of several thousand fish. These counts appear to be roughly double the current mean lake abundance, considering that they were likely conducted upstream from fisheries in or near to the Ozette River. Makah Fisheries Management (MFM 2000) concluded that there appears to be a substantial decline in the Tribal catch of Ozette Lake sockeye salmon beginning in the 1950's and a similar decline in run size since the 1920's weir counts reported by Kemmerich (1945). No further enumeration of the run was conducted until 1977 (Jacobs *et al.* 1996)

NMFS reported that recent year sockeye salmon escapements averaged below 1,000 adults per year, with low years dropping to only a few hundred fish (Gustafson *et al.* 1997). This abundance status implied a moderate degree of risk from small-population genetic and demographic

variability with little room for further declines before abundances reached critically low levels (Gustafson *et al.* 1997). Recent run size estimates and analysis of previous estimation methods indicate that sockeye abundance within the ESU may be relatively stable or increasing in recent years, presumably with the help of the hatchery supplementation and reintroduction program. The 1977-99 average annual abundance level for the total Ozette Lake sockeye return was 1,075 (range 263 to 2,191; excludes 1981, 1985, and 1987 due to lack of data) (MFM 2000). The most recent four year annual mean run size from 1996 to 1999 for this predominately four-year-old age at return population was 1,598 adults (range 1,133 to 2,076; MFM 2000). This most recent four year mean escapement average compares to a mean escapement of 811 for the four previous years of the cycle (1992-1995, range less than or equal to 267 to 2,548). The 1996-1999 mean lake escapements for beach-origin and tributary (hatchery)-origin sockeye were 1,424 and 156, respectively. Sockeye salmon originating from Ozette Lake tributaries (first generation hatchery and/or natural-origin recruits) comprised an average of 9.8% of the total escapement in recent years (NMFS 2001c).

An updated NMFS analysis of total annual Ozette Lake sockeye salmon abundance (based on adult run size data presented in Jacobs *et al.* 1996) indicates a trend in abundance averaging –2.0% per year over the period 1977 through 1998 (NMFS 1998). The current tributary-based hatchery program was planned and initiated in response to the declining population trend identified for the Ozette Lake sockeye salmon population. The updated analysis also indicated that the most recent ten year (1989-98) trend for the total population is +2% per year (NMFS 1998), improving from the -9.9% annual trend reported in Gustafson *et al.* (1997). From the NMFS VSP document, a spawner to spawner ratio of greater than 1 to 1, as may be indicated by a slightly increasing abundance trend for Ozette Lake sockeye salmon, is one criterion necessary for population viability (NMFS 2000a).

The adult sockeye salmon return to Umbrella Creek established through Makah Tribal hatchery juvenile fish releases has contributed to overall sockeye salmon abundance in recent years. Tributary adult returns averaged more than 10% of the total run size from 1995 to 1999, and comprised approximately 50% of the large return in 2000 of 4,500 sockeye salmon. In 1999, natural-origin recruit sockeye salmon spawners were approximately 40% of the total estimated Umbrella Creek escapement of 400 fish.

All of the above aspects of historic viability of the population as a whole, as well as for individual spawning aggregations on lake beaches or in tributaries, are poorly understood. Estimates of historic (1977 through 1996) abundance of sockeye salmon returns to the Ozette Lake Basin have been published (WDF and WWTIT 1994; Jacobs *et al.*1996; Gustafson *et al.* 1997). However, estimates prior to 1996 cannot be considered reliable due to inconsistent enumeration methods. A detailed analysis of potential errors and deficiencies in past run size estimation methods is summarized in the HGMP (MFM 2000).

Since accurate estimates of the overall run size are not available for consecutive four-year brood cycles, trends in overall abundance and productivity are unclear, but can be determined in the

future from the new underwater video camera methods. The abundance and productivity of beach spawning aggregations are unknown but are under investigation. On-going sockeye salmon adult tagging and hydroacoustic research should help to gain a better understanding of pre-spawning mortality and spawner abundance on the lake beaches.

There has been no harvest of Ozette Lake sockeye salmon for the past four brood cycle years (16 years). Prior to that time, in the 1970s and early 1980s, ceremonial and subsistence harvests by the Makah Tribe were low, ranging from 0 to 84 fish per year. Over the 10 years prior to the early 1970s, commercial harvests by the Makah Tribe remained minimal, averaging less than 500 fish per year. Harvest has not been an important mortality factor for the population in over 35 years. In addition, due to the early river entry timing of returning Ozette Lake sockeye salmon (beginning in late-April, with peak returns prior to late-May or mid-June), the fish are not intercepted in Canadian and U.S. marine area fisheries directed at Fraser River sockeye salmon. There are currently no known marine area harvest impacts on Ozette Lake sockeye salmon.

Ozette Lake sockeye are reported to be genetically distinct from other populations in Puget Sound (Winans *et al.* 1996), and from other Washington coastal populations (Gustafson *et al.* 1997). Hershberger *et al.* (1982) surveyed genetic variation at 37 allozyme loci (only two of which were polymorphic) in sockeye salmon from Ozette Lake. These authors reported that genetic variation evidenced in their analysis suggested that two groups (or populations) of sockeye salmon may be present in Ozette Lake, separated by a difference in run-timing. Further analysis suggests that sockeye spawning at Allens' Bay and Olsen's Beach may also be genetically distinct (Dlugokenski *et al.* 1981). Gustafson *et al.* (1997) reported differences in allozyme genetic data among the Allen's and Olsen's beach spawning aggregations. However, the differences between years at the same given spawning location were also found to be as great as the differences between beaches, suggesting that the aggregations may be a single population, with the genetic differences observed reflecting natural variation within the lake population.

Determining the genetic composition of *O. nerka* spawning aggregations in the Ozette Lake Basin is important, and needed for decision-making with regard to ESA protection, as well as for determining what rearing and release strategies may be appropriate if supplementation or reintroduction are needed to recover beach spawning aggregations. In a collaborative attempt to determine the genetic composition of all *O. nerka* spawning aggregations in the Basin, the Makah Tribe, the Northwest Indian Fisheries Commission (NWIFC), and WDFW have compiled a list of all genetic samples that have been collected to date (MFM 2000). These samples, once analyzed, comprise the best available science to characterize genetic composition of extant sockeye salmon spawning aggregations in Ozette Lake, and to distinguish and monitor potential hybridization among kokanee and sockeye.

Factors responsible for the decline of Ozette Lake sockeye salmon are thought to include (from Dlugokenski *et al.* 1981; Jacobs *et al.*1996; MFM 2000):

1) loss of adequate quality and quantity of spawning habitat;
2) predation and disruption of natural predator–prey relationships;
3) introduction of non-native fish and plant species;
4) past over-exploitation in fisheries;
5) poor marine survival; and
6) the synergistic cumulative effects of these factors.

In the tributaries and on certain lake beaches, these factors are believed to have resulted in extirpation of locally adapted spawning aggregations and of life history strategies necessary for successful spawning.

A multitude of factors likely contributed to the current, depressed abundance status of Ozette Lake sockeye salmon. As noted, poor marine survival caused by natural environmental fluctuations was likely an important causative factor for the population decline. However, it is clear that anthropogenic factors have considerably altered critical habitat, and also played an important role in the decline of the ESU. These human-induced factors have likely reduced the species' resiliency to such natural factors for decline as drought and poor ocean conditions. Human-induced factors contributing to the decline of the ESU include the cumulative effects of intensive land-use practices during the last century and continuing presently, particularly timber harvest and agriculture, and associated stream-clearing and road-building (Dlugokenski *et al.* 1981; MFM 2000; Gustafson *et al.* 1997). Cumulative land-use effects comprise an important factor limiting the productivity of naturally-produced sockeye salmon within the lake and its tributaries.

The decline in productivity of Ozette Lake sockeye is thought to be primarily attributed to reduced area and quality of spawning and incubation habitat. Limited suitable spawning area could be responsible for redd superimposition at Olsen's Beach (MFM 2000; Dlugokenski *et al.* 1981). Fine sediment levels (smaller than 0.85 mm) measured in 1999 averaged 25 percent, with maximums of 44% on Allen's Beach and 43% on Olsen's Beach, and minimums of 5% on Allen's Beach and 9% on Olsen's Beach. High fine sediment levels in Ozette Lake tributaries (17.1% average in Big River and Umbrella Creek) are above proportions found to compromise salmon egg to fry emergence survival (McHenry *et al.* 1994). Increased levels of fine sediment are also responsible for a myriad of other tributary and lake habitat impacts, including sedimentation of outwash fans, embedding and cementing of spawning substrate, and pool filling. All of these impacts attached with sedimentation are detrimental to salmon productivity.

Sedimentation and hydrologic changes have likely fostered the growth of native willow and sedge species as well as exotic reed canary grass and other shoreline pioneering vegetation, which further increase sedimentation. Removal of large woody debris from the Ozette and Big rivers has been hypothesized to cause more abrupt fluctuations in lake level, which may reduce wave energy on the shorelines, resulting in altered particle size distribution along the longitudinal axis of the beach. Functionally, the removal of woody debris from the two largest rivers in this Basin

(Ozette River and Big River) may have decreased gravel-cleaning in beach-spawning areas and increased fine sediment deposition and plant growth. The depressed abundance of the beach-spawning sockeye salmon aggregation is expected to reduce annual, natural gravel cleaning by spawning adult sockeye (e.g., Montgomery *et al.* 1996).

Primary and secondary productivity in Ozette Lake is not likely limiting the growth and survival of rearing sockeye salmon, nor causing any competitive disadvantage for juvenile sockeye salmon (Beauchamp *et al.* 1995). Out-migrant sockeye smolts exhibit robust condition, as previously described. However, the depressed abundance status of sockeye salmon and other anadromous salmon populations in the Basin has limited the deposition of salmonid carcasses in the lake and its tributaries, as a result of dying after spawning, or dying during unsuccessful upstream migration. As mentioned previously, the historical amounts of ocean-origin nutrients available to the Ozette Lake ecosystem from salmon carcasses was likely large, contributing to the enhancement of organisms that natural-origin juvenile sockeye and other salmon feed upon during rearing. In addition, studies of the influence of carcass-derived nutrients on sockeye salmon productivity suggest a positive feedback mechanism related to increased sockeye salmon spawner escapement and carcass deposition (Schmidt *et al.* 1998). The productivity of Ozette Lake does not currently appear to be limiting sockeye salmon productivity and survival at current depressed abundance levels. If the sockeye population rebounds to higher abundance levels, input of nutrients afforded by spawning and dying sockeye may become more critical for sustaining stable, high smolt productivity levels in future years.

Depressed salmon population abundances have also likely led to a diminishment of the beneficial effects to spawning areas and salmon survival afforded by the physical activity of salmon spawning. Spawning-related stream-bed modifications by salmon may benefit embryo survival by coarsening spawning gravel, reducing the potential for egg suffocation, and scour of incubating eggs and alevins during flood events (Montgomery *et al*. 1996). The decrease in the number of beach and tributary spawning salmon in the Basin may be contributing to loss of spawning substrates important for salmon production.

Washington Coastal/Puget Sound Dolly Varden/Bull Trout (Salvelinus confluentus)
The Washington Coastal/Puget Sound Dolly Varden/Bull trout distinct population segment was listed as threatened by USFWS under the ESA on June 10, 1998. Bull trout are not present in the Ozette Lake Basin (WDFW 1999).

No other listed salmonids are present in Washington Coastal watersheds adjacent to the Ozette Lake Basin. Sockeye salmon originating from the hatchery programs proposed in the RMP are not expected to have any substantial effects on listed salmon populations in other west coast regions as a result of straying.

3.2.2 Status of Unlisted Fish Species

Salmonids

Seven salmonid species occur in the Ozette Lake Basin. In addition to sockeye salmon, coho salmon (*O. kisutch*), chum salmon (*O. keta*), chinook salmon (*O. tshawytcha*), kokanee (*O. nerka*), steelhead (*O. mykiss*), and sea-run cutthroat trout (*O. clarki*) are endemic to the Ozette Lake Basin (Beauchamp *et al.*1995; Jacobs *et al.*1996; MFM 2000). However, chinook salmon have not been detected in the Ozette Lake watershed for several decades, although no systematic surveys have been conducted in the fall in the Ozette River to detect their presence over this period. The Ozette River is used for spawning or rearing, and as a migration corridor, by coho salmon, chum salmon, steelhead, and sea-run cutthroat trout. Resident salmonids, including cutthroat trout, kokanee, and rainbow trout (*O. mykiss*), and rearing juvenile anadromous salmonids, including coho salmon, sea-run cutthroat trout, and steelhead, are present year-round in Ozette Lake. These other salmonid species inhabiting the Washington coastal regional watersheds were determined through Federal species status review processes to be healthy in population status, and not warranting listing under the ESA (Weitkamp *et al.* 1995; Johnson *et al.* 1997; Myers *et al.* 1998; Gustafson *et al.* 1997; Busby *et al.* 1996).

Kokanee Salmon (Oncorhynchus nerka)

Kokanee salmon (i.e., resident sockeye salmon) are native to the Ozette Lake system. Adult spawners are present in the lake and in tributaries from November to January annually. Although the population size of kokanee has been poorly documented in the Ozette Lake Basin, Beauchamp *et al.* (1995) estimated that approximately 7,500 kokanee may spawn in the tributaries annually. When attempts were made to capture kokanee-sized *O. nerka* for genetic tissue sampling in the 2000 spawning season from tributaries, kokanee-sized *O. nerka* could only be found in sufficient abundance to be captured in Crooked and Siwash Creeks. One kokanee-sized fish was also captured from a deep pool in Umbrella Creek, though less than 10 were observed during the entire survey season (Mike Crewson, MFM, pers. commun. 2001).

The inability to find kokanee in other small streams in 2000 may have been hampered by low fall rain and flows. In 2001 surveys, kokanee were found in five tributaries (Mike Crewson, MFM, pers. commun. 2001). In addition to Siwash and Crooked Creek aggregations, substantial numbers of kokanee were observed in Elk Creek and an unnamed tributary (WRIA number 20.0073) to Ozette Lake near Elk Creek, located on the east side of the lake. Smaller aggregations were observed in another small tributary to Ozette Lake near Rayonier Landing. All kokanee streams are located on the eastern side of the lake. Numerous additional tributaries were inspected for kokanee in 2001, including Palmquist Creek, South Creek, Cedar Creek, Quinn Creek, Dunham Creek, Coal Creek, and assorted unnamed tributaries, but no kokanee were found in these streams (Mike Crewson, MFM, pers. commun. 2001).

Substantial numbers of kokanee-sized *O. nerka* have been observed on spawning beaches in Ozette Lake along with spawning sockeye salmon (MFM 2000). Juveniles of both species occupy the same habitat, as post-emergent fry, and while rearing in the pelagic zone of the lake

(Beauchamp *et al.* 1995). Through hydroacoustic surveys, Beauchamp *et al.* (1995) estimated that approximately 90% (395,000) of the total offshore fish abundance estimate of 439,000 were kokanee and sockeye salmon.

Coho Salmon (Oncorhynchus kisutch)

Coho salmon are also native to the Ozette Lake system. Although historic abundance is unknown, the population appears to have been extremely productive, based upon the observation of over 10,000 coho that were enumerated in two days in 1925 at an adult weir as they entered Ozette Lake (Kemmerich 1945). No large freshwater fisheries have been directed at adult Ozette Lake coho salmon for the last 30 years, and ocean fisheries are regulated to conserve Washington Coastal stocks. There are no hatchery releases of coho salmon in the Ozette Lake watershed. Adult coho spawners enter the tributaries of Ozette Lake from mid-October through January annually (WDF and WWTIT 1994). Adult coho have been observed since 1998 by MFM between mid-October to late-January in nine different survey reaches within Ozette Lake tributaries. Prior to these efforts, no systematic coho stock assessment work had been conducted in this watershed in many years.

Coho fry emigration peaked near the third week of April 1999, at over 4,500 coho fry out-migrants per day in Umbrella Creek (Mike Crewson, MFM, pers. commun. 2001). Juvenile coho rearing in the lake was only recently documented. Nearly 60,000 coho fry were enumerated out-migrating from Umbrella Creek in 1999 (MFM 2000). This likely underestimates coho fry migration from Umbrella Creek to Ozette Lake in 1999, because sampling was interrupted by high flows. In addition, it was observed that a similar number fo coho fry to the number that out-migrated remained within Umbrella Creek. Since there are more coho in the Big River system than in Umbrella Creek, up to several hundred thousand coho fry may have reared in Ozette Lake from the spring,1999, out-migration, and in these two tributaries in the spring of 1999, with a considerable portion entering the lake as sub-yearling fish (MFM 2000). Snorkel surveys by the Makah Tribe found large numbers of coho fry residing along shoreline areas of the lake. It appeared that at least as many fry remained in the tributaries, demonstrating an alternative riverine juvenile life history strategy for some of the population. No considerable smolt out-migration was observed in over a month of trapping during the peak regional out-migration time, indicating that many coho parr may over-winter in Ozette Lake.

Habitat classification, combined with increased survey effort in 1999 and 2000, have enabled estimation of annual coho salmon escapements for Basin tributaries since 1999 (Mike Crewson, MFM, pers. commun. 2001). Final estimates of the total coho spawning aggregation in the Ozette watershed are not yet available. However, both the peak counts from spawning surveys and the juvenile out-migration data indicate the existence of a substantial population that exhibits unique life history characteristics. Systematic spawner surveys for Ozette Lake coho would continue as part of the regular stock assessment schedule conducted by MFM, with the intent of developing annual coho escapement estimates for the watershed. These surveys are a separate fisheries management function implemented by the co-managers, and would continue regardless of Ozette Lake sockeye salmon management alternatives that are selected for application.

Cutthroat Trout (Oncorhynchus clarki)

Cutthroat trout are also native to the Ozette Lake Basin, inhabiting both the lake and tributary streams. Anadromous cutthroat are also found in the system, although they are highly migratory and may originate from other watersheds. Cutthroat spawn in tributaries to Ozette Lake in late winter, but spawning abundance data are lacking for this species. Cutthroat trout are present during sockeye spawning and egg deposition in tributaries and on lake beaches. A cutthroat trout, captured by gillnet on November 29, 2000 on Olsen's Beach, was found to be gorged with sockeye salmon eggs (MFM unpublished field notes 2000).

Cutthroat trout have been observed interacting with juvenile sockeye salmon in nearshore and offshore areas in Ozette Lake during their entire freshwater rearing cycle (Dlugokenski *et al.* 1981; Beauchamp *et al.* 1995). Large numbers of large cutthroat trout were also captured along with emigrating salmon and steelhead smolts in the Ozette River during 2001 (MFM unpublished data).

Although cutthroat trout captured in nearshore areas were found to consume sockeye fry, there is no evidence that cutthroat trout consume large numbers of juvenile sockeye during their nearshore residence period (Beauchamp *et al.* 1995). Cutthroat trout have been observed to consume large numbers of eggs on spawning beaches (Dlugokenski *et al.* 1981; MFM unpublished field notes, 2000). Beauchamp *et al.* (1995) suggested that this species could exert considerable control over sockeye salmon abundance due to offshore predation, where 40% of the diet of large cutthroat trout was found to consist of age 0 and age 1 sockeye salmon and kokanee. Beauchamp *et al.* (1995) estimated that for every 1,000 cutthroat trout greater than 300 mm, 138,900 age-0 and 27,000 age-1 *O.* nerka were consumed. Biomass estimates of cutthroat trout have not been made in Ozette Lake, although Beauchamp *et al.* (1995) speculated that the population of large cutthroat was between 5,000 and 10,000 fish.

Steelhead/Rainbow Trout (Oncorhynchus mykiss)

Rainbow trout and steelhead are also native to the Ozette system. Adult winter-run steelhead migrate through the Ozette River and Ozette Lake to the tributaries from late-October through May, with spawning occurring from mid-February to early-June annually. Juvenile steelhead reside for two or three winters in the lake and tributaries before emigrating seaward as smolts from late-spring through early-summer. Small numbers of age 0+, 1+, and 2+ steelhead were also trapped by fyke net as they emigrated from Umbrella Creek in the spring of 1999 and through screw trap operation in the Ozette River in 2001 (MFM unpublished data).

The level of predation by steelhead on juvenile sockeye in the Ozette Lake Basin is unknown, but may warrant study. Beauchamp (1995) reported that wild steelhead smolts were the primary predator of sockeye salmon fry migrating from the Cedar River into Lake Washington, a western Washington lake east of Seattle. Steelhead smolts were estimated to have consumed 6.8 million Cedar River sockeye salmon fry emigrating in 1985, or about 15% of the estimated total emergent fry production for the river that year.

Chinook and Chum Salmon (Oncorhynchus tshawytscha and *O. keta)*
Chinook and chum salmon were historically abundant in the Ozette Lake Basin (MFM 2000). Both chinook and chum salmon were known to spawn in the mainstem of the Ozette River, and chum salmon adults were historically reported spawning in Big River and Umbrella Creek. As noted above, chinook salmon have not been detected in the Ozette Lake watershed for several decades. Chum salmon have declined to the point where they are detected very infrequently, and are probably functionally extinct. Small numbers of chum salmon have been observed spawning in Umbrella Creek over the past four years, and chum outmigrating fry were subsequently trapped in the Umbrella Creek fyke net study in 1999, and during 2001 Ozette River smolt trap monitoring and research (MFM unpublished data). The decline in harvest and apparent extirpation of these stocks may be correlated with stream clearing activities in the Ozette and Big Rivers conducted in the past (see section 3.1, above).

Non-salmonid Fish Species
Non-salmonid fishes present in the Ozette Lake Basin include northern pikeminnow (*Ptychocheilus oregonensis*), Olympic mudminnow (*Novumbra hubbsi*), Pacific lamprey (*Entosphenus tridentata*), River lamprey (*Lampetra ayresi*), prickly sculpin (*Cottus asper*), largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavencens*), peamouth (*Mylocheilus caurinus*), red-sided shiner (*Richardsonius balteatus*), and three-spine stickleback (*Gasterosteus aculeatus*) (Gustafson *et al.* 1997; MFM 2000).

Northern pikeminnow (Ptychocheilus oregonensis)
Northern pikeminnow are abundant in the Ozette River and in Ozette Lake and are assumed to be native to the Ozette Lake Basin (MFM 2000, quoting John Meyer, NPS, personal communication), although this assumption has not been thoroughly studied (Jacobs *et al.* 1996). Northern pikeminnow occur in nearshore and offshore zones where they interact with juvenile sockeye during their entire freshwater rearing cycle. Biomass estimates for the northern pikeminnow population in Ozette Lake are lacking.

Similar to cutthroat trout, northern pikeminnow have not been found to prey on sockeye juveniles in nearshore areas (Dlugokenski *et al.* 1981; Beauchamp *et al.* 1995). However, Beauchamp *et al.* (1995) found that large northern pikeminnow in offshore areas consumed sockeye salmon and kokanee. For every 1,000 northern pikeminnow exceeding 300 mm, 5,600 sub-yearling sockeye salmon and kokanee may be consumed per year (Beauchamp *et al.* 1995). Large numbers of northern pikeminnow were observed transiting the Ozette River during the sockeye salmon smolt emigration period in recent years, and northern pikeminnow have been observed preying on salmon smolts in the vicinity of the adult counting weir in the Ozette River (MFM unpublished data). As with cutthroat trout, predation impacts by northern pikeminnow on Ozette Lake sockeye abundance remain unknown, due to the lack of abundance biomass estimates for these species.

Olympic mudminnow (Novumbra hubbsi)
Although their spatial distribution is extensive in the Ozette Lake Basin, possibly indicating decades of occupation, the indigenous origin of Olympic mudminnows in the Basin has questioned (Jacobs *et al.* 1996, quoting Harris 1974). They are rarely seen and their abundance in the Basin is unknown. Olympic mudminnows utilize low energy swamps and bogs. They appear to be non-selective feeders, and are not considered a major competitor with sockeye salmon.

Lamprey (Lampetra tridentata and *L. ayresi)*
Pacific lamprey and river lamprey have been found in the Ozette Lake Basin. The abundance and distribution of these species is not well understood. Their interactions with sockeye salmon have not been documented to any significant extent.

Prickly sculpin (Cottus asper)
Prickly sculpin are also native to the Ozette Lake Basin, having temporal and spatial overlap in occurrence with adult beach-spawning sockeye salmon and with out-migrating juvenile sockeye salmon fry in tributaries. Sculpin have been known to prey on sockeye salmon eggs in Ozette Lake (Beauchamp and LaRiviere 1993). More than 200 sculpin were collected during fry fyke netting in Umbrella Creek in 1999, and many sculpin were observed during beach spawner surveys in Ozette Lake that year. Sculpin in Umbrella Creek appeared to selectively feed on swim-up sockeye fry inside a livebox trap, independent of prey density (which was dominated by coho fry) or size (at times, smaller steelhead fry predominated but were not preyed on by sculpins at as high of a rate as were sockeye fry)(Mike Crewson, MFM, pers. commun. 2001). This was postulated to be due to the inclination of sockeye salmon fry to hide motionless on the bottom substrate where the sculpin also resided.

Largemouth Bass (Micropterus salmoides)
Very little is known about largemouth bass in Ozette Lake, particularly their biomass, distribution, or predation rates on juvenile sockeye. This introduced species is piscivorous and is numerous enough in Ozette Lake to be targeted and commonly caught by recreational anglers. The stomachs of six largemouth bass necropsied by Beauchamp and LaRiviere (1993) exclusively contained fish, identified primarily as yellow perch and sculpin (Jacobs *et al.* 1996).

Yellow perch (Perca flavencens)
Yellow perch are an introduced species in Ozette Lake. Young perch feed on zooplankton and may have dietary overlap with juvenile sockeye, although their distribution in Ozette Lake is not known (Jacobs *et al.* 1996). Older perch (greater than 150 mm fork length) have been found exclusively in nearshore environments, and their diet typically consists of invertebrates and fish (Jacobs *et al.* 1996). Adult perch predation on juvenile sockeye salmon has not been documented.

Peamouth Chub (Mylocheilus caurinus)
Peamouth chub have little overlap with sockeye juveniles in nearshore habitats, and are much less abundant in offshore habitats of Ozette Lake (Dlugokenski *et al.* 1981; Beauchamp *et al.* 1995).

Peamouth eat some sockeye salmon eggs on the spawning beaches, but the extent of their egg predation is unknown (Jacobs *et al.* 1996). The diet of peamouth is dominated by benthic prey throughout the year (Beauchamp and LaRiviere 1993). Beauchamp and LaRiviere (1993) found that small peamouth occur in the offshore areas at depths of 1 to 40 meters with larger individuals occupying nearshore areas (Jacobs *et al.* 1996).

Peamouth chub have considerable overlap with sockeye salmon juveniles in Umbrella Creek. Thousands of sexually mature peamouth chub have been observed migrating into the creek in dense schools for short periods, and exhibiting spawning behavior. On two separate occasions in Umbrella Creek, peamouth were sampled to determine maturity and stomach contents. On one occasion they were ripe and had benthic prey in their stomachs; on another occasion, they were spawned out and emaciated. Substantial gravel cleaning has been observed coincident with peamouth presence in tributaries (MFM unpublished field notes). In addition, sexually-mature peamouth chub were observed migrating down the Ozette River in late-spring/early-summer, presumably to spawn (MFM unpublished data). While no direct predation has been observed, there is a potential for competition between emigrating sockeye salmon smolts and peamouth in the Ozette River.

Redside shiner (Richardsonius balteatus)

Redside shiners are presumed to be native in Ozette Lake, although little is known about their temporal or spatial distribution or their abundance. Redside shiner are omnivorous. Fry feed on zooplankton and algae, and adults feed on insects, snails, zooplankton, and at times may consume fish eggs and fry (Jacobs *et al.* 1996). Predation on sockeye fry may occur in the nearshore environment and in tributaries. Small numbers of redside shiner were observed during fyke net trapping in Umbrella Creek in 1999, and during smolt trapping in the Ozette River in 2001 (MFM unpublished data). Redside shiners are known to exhibit diel migration patterns between nearshore and pelagic habitats, and may compete with juvenile sockeye salmon for zooplankton when in pelagic areas.

Threespine stickleback (Gasterosteus aculeatus)

Threespine sticklebacks often overlap in diet and distribution with salmonids. However, the absence of data on this species suggests low stickleback abundance in Ozette Lake. MFM staff have observed only small numbers of sticklebacks during surveying and trapping activities in recent years (MFM unpublished field notes). Jacobs *et al.* (1996) hypothesized low threespine stickleback abundance and little spatial and temporal overlap with sockeye salmon, based upon failure to capture any sticklebacks in minnow traps set in offshore habitats, and their absence in cutthroat trout stomachs. However, threespine sticklebacks are reported to be closely associated with sockeye salmon fry during rearing in Alaskan lakes (Ruggerone 1992). Controlled studies indicate that intermingling of the two species may potentially create a refuge from coho salmon predation for sockeye fry, as coho salmon actively avoid threespine sticklebacks as a prey item (Ruggerone 1992).

Non-salmonid marine fish species
Non-salmonid marine fish species, including sculpins (*Cottus* sp.), flounders (e.g., Pleuronectidae), perch (e.g., *Embiotocidae*), greenlings (Hexagrammidae), rockfish (*Sebastes* spp,), and spiny dogfish (*Squalus acanthias*) are present in coastal waters where sockeye salmon are present as in-migrating adults and emigrating juveniles. Ecological interactions among these marine fish populations with Ozette Lake sockeye salmon are unknown.

3.2.3 Terrestrial Species Listed Under the ESA

There is one animal in the Olympic Peninsula region listed under the Federal ESA as endangered and four listed as threatened. The endangered animal is the brown pelican (*Pelecanus occidentalis*). The four animals listed as threatened are the marbled murrelet (*Brachyramphus marmoratus*), Northern spotted owl (*Strix occidentalis caurina*), Oregon silverspot butterfly (*Speyeria zerene hippolyta*) and the bald eagle (*Haliaeetus leucocephalus*). The American peregrine falcon (*Falco peregrinus anatum)* is also present in the region. This raptor species was recently classified as recovered, and delisted (64 FR 46541, August 25, 1999).

There are four bald eagle nesting territories within the HGMP action area (USFWS 2000). Bald eagle nesting activities occur from January 1 through August 15. The bald eagle wintering period extends from October 31 through March 31. Bald eagles prey on anadromous salmon, including live and dead sockeye salmon adults, in the Basin. A bald eagle was observed consuming an adult female sockeye carcass on Olsen's Beach in 1999 (MFM unpublished field notes). The northern spotted owl also occurs in the action area. Nesting activities for this species occur from March 1 through September 30 (USFWS 2000). No other listed terrestrial species were noted in the Ozette Lake Basin (USFWS 2000).

3.2.4 Other Aquatic and Terrestrial Resources

Harbor seals (*Phoca vitulina*), river otters (*Lutra canadensis*), raccoons, beaver, black bear, piscivorous birds, shorebirds, song birds, raptors, crayfish, and aquatic invertebrates are present in the HGMP implementation area. Recent studies by NMFS and the Makah Tribe suggest that predation rates on adult sockeye salmon by river otters, harbor seals, and sea lions in the Ozette Lake Basin and adjacent marine areas are considerable, and a potential factor for decline of the listed sockeye salmon population (Gearin *et al.* 1998; MFM 2000; NMFS 2000b). These terrestrial and aquatic organisms are also likely to feed upon the carcasses of adult sockeye salmon after the fish have spawned in the tributaries and lake. The marine mammal species and piscivorous birds that may interact with sockeye salmon are further addressed below.

River Otters (Lutra canadensis)
River otters are native to the Ozette River Basin, and overlap extensively with adult sockeye salmon during spring and summer (April through August) salmon migration up the Ozette River. No abundance estimates of river otter populations are available for the Ozette Lake Basin, though river otters were observed on 274 occasions in 1999 in the Ozette River (MFM 2000). The

Ozette River provides excellent river otter habitat. Mature forest provides adequate cover and woody debris for den sites, and cohesive cut banks make ideal surfaces for otter slides. A variety of food sources, including crayfish, mussels, salmonids at all life stages, northern pikeminnows, peamouth chub, sculpin, and various other fish species, provide suitable year-round forage. Because of ideal habitat conditions and minimal human disturbance, river otter distribution on the Ozette River is probably primarily influenced by their territorial behavior.

Interactions between river otters and adult sockeye salmon occur in the Ozette River. Direct observations of otters preying on adult sockeye were recorded in 1998, 1999, and 2000 (MFM 2000). In 1999, video footage recorded three instances of direct otter predation on adult sockeye, including footage of adult sockeye salmon being carried by otters to and from Ozette Lake.

In 1999, Makah Fisheries Management observers documented 34 occasions when they could hear or see nocturnal otter predation, all presumably on migrating adult sockeye salmon, occurring within 150 meters of the weir (MFM 2000). Included were seven direct observations of river otters consuming adult sockeye salmon.

Partial remains of adult sockeye salmon were observed on the banks of the Ozette River in the summers of 1998 and 1999 with otter scat (Gearin *et al.* 1998; MFM 2000). Recent otter scat analyses have focused on the upstream reach of the Ozette River, where nearly all of the otter predation has been observed to date. In a recent study, adult sockeye scarring rates recorded between fish capture and marking at the river mouth, and recapture at the lake outlet, ranged from 13% to 17% (MFM unpublished data for 2000). Gearin *et al.* (1998) noted that river otter predation is a cause for concern because they are "adept predators and are fully capable of preying on adult sockeye in the narrow and shallow water conditions in the upper river."

Based on studies conducted in 1998, 1999, and 2000, the Makah Tribe and the NMFS National Marine Mammal Laboratory staff are developing estimates of freshwater and ocean scarring incidence attributable to predation attempts. Their work will also determine the estimated proportion of injuries attributable to each marine mammal predator species.

Harbor Seals (Phoca vitulina)

Harbor seals are native to the Ozette Lake region. They are found in the Ozette River, in Ozette Lake, and in substantial numbers in the nearshore marine environment. Gearin *et al.* (1998) determined that more than 1,000 harbor seals inhabited an area within 5.5 kilometers of the river mouth. Seals were observed entering the river in five out of nine days surveyed in 1998, with up to three seals present in the river at times (Gearin *et al.* 1998).

Harbor seals have diverse diets. Scat samples collected in the nearshore environment in 1998 contained at least 37 species of prey, although none contained sockeye salmon remains (Gearin *et al.* 1998). The primary prey of harbor seals in nearshore marine habitat included pacific tomcod, smelt, and whiting. Other important components of harbor seal diets included herring, shad, and

sardine. Although seals have been observed in Ozette Lake and the Ozette River for extended periods, no scat samples that could be used to indicate their diet have been collected in these areas.

Harbor seal habitat utilization overlaps extensively with adult sockeye salmon during the April through late-July adult fish migration period in the Ozette River. Harbor seals follow the sockeye salmon up the Ozette River into Ozette Lake, and seal predation attempts on adult sockeye salmon have been observed at the mouth of the river, and at the lake outlet. The frequency of seal/sockeye interactions appears to directly correlate to Ozette River flow and the tidal cycle affecting the lower river (Gearin *et al.* 1998; MFM unpublished data). Harbor seals are frequently observed in the upper Ozette River in late spring and into summer, overlapping to a large degree with sockeye salmon presence in the river. Underwater video recordings from the adult sockeye salmon counting weir, located on the upper Ozette River, showed harbor seals transiting the weir at least 20 times in 1999 (MFM 2000). Harbor seals were also visually observed eating sockeye salmon within 150 meters of the weir on five occasions in 1999 (MFM unpublished data). Seals have been seen frequently in the upper river until mid-June when average lake level is greater than 33 feet. As the lake level drops throughout the summer, and subsequently, river depth also drops, seal observations, and seal/sockeye interactions become less frequent. During low flows, seals are not observed in the upper river, presumably because it is more difficult for them to access that portion of the river.

NPS, NMFS National Marine Mammal Laboratory, and MFM personnel have observed seals in the lake from October through early-June in past years. Harbor seal presence in Ozette Lake was recorded during surveys conducted throughout the sockeye spawning season from October through January during the years 1998 through 2001 (MFM unpublished data). These surveys regularly observed harbor seals in close proximity to both Olsen's and Allen's beaches, and where sockeye were known to congregate at the mouth of Umbrella Creek.

Seals have been observed chasing adult coho salmon onto the lakeshore. It is presumed that seals follow the adult coho salmon run into the lake when water levels rise in the fall and winter months. No direct sockeye salmon predation has been observed in the lake. However, seals have been observed foraging and pursuing prey in the littoral zone while sockeye are staging and actively spawning off of the lake beaches. Sockeye salmon heads that were bitten off below the operculum were also frequently recovered during snorkel surveys at the spawning beaches. It was presumed that many of these fish had not yet spawned (MFM 2000). Several individual seals have apparently learned the location of both beach spawning aggregations, and appear to have focused predation on beach spawning Ozette Lake sockeye (MFM 2000).

Seal predation was identified by Gearin *et al.* (1998) as a "cause for concern given the small size of the sockeye population, because even a small number of seals could potentially consume a significant number of fish."

Sea Lions

California sea lions (*Zalophus californianus*) and Steller sea lions (*Eumetopias jubatus*) are migratory species found seasonally along the outer Washington coast, and in high abundance near the Ozette River mouth. In 1998, within approximately 18.5 kilometers from the Ozette River mouth during the adult sockeye salmon migration, California sea lion counts ranged from 0 to 541 individuals, and Steller sea lion numbers were found to range from 404 to 1,016 (Gearin *et al.* 1998). Sea lions overlap spatially and temporally with outmigrating Ozette Lake sockeye smolts and returning adults, particularly in nearshore marine habitats. Approximately 30% of the 82 adult sockeye salmon captured in the lower river estuarine area during a predation study in return year 2000-2001 carried scars (MFM 2000). Many of the scars were older, and appeared to be predator related. Measurements of inter-canine tooth scarring distance indicated that many of the bites appeared to have been caused by sea lions (MFM and NMFS NMML unpublished data).

Piscivorous Bird Species

A number of avian piscivores inhabit or migrate through the Ozette Lake Basin, overlapping spatially and temporally with Ozette Lake sockeye salmon. Ozette Lake provides ideal habitat for these species as it is moderately productive, remote, protected, and situated in a major migratory bird route (the Pacific flyway). Species present include belted kingfishers (*Ceryle alcyon*), bald eagles, marbled murrelets (*Brachyramphus marmoratus*), common mergansers (*Mergus merganser*), hooded mergansers (*Lophodytes cucullatus*), great blue heron (*Ardea herodias*), osprey (*Pandion haliaetus*) and several species of gulls (family Laridae). Other avian piscivores are present as well, but a comprehensive inventory has not been published. Common mergansers have been observed eating salmon smolts in the Ozette River near the lake outlet (Mike Crewson, MFM, personal communication). Up to 20 mergansers and numerous kingfishers were observed foraging for salmon smolts and other unidentified fish species near to the mouth of the Ozette River in 1999 (Kirt Hughes, MFM, personal communication). As noted previously, a bald eagle was observed consuming an adult female sockeye on Olsen's Beach in 1999 (MFM unpublished field notes). Many prey species are available and abundant for the variety of avian piscivores feeding in the Ozette Lake Basin.

3.3 Cultural, Recreational, and Economic Environment

This section describes the cultural, recreational, and economic resources of the Treaty Tribes and the State of Washington that may be affected by the proposed action.

3.3.1 Cultural Environment

The rich yield of fresh and saltwater animals historically provided major support to the way of life for the region's tribes. In particular, salmon served as a primary food source for tribes inhabiting the Washington Coastal region. In addition to its importance as food, salmon also served as a fundamental part of the Indian Tribal culture (Kruckeberg 1991). The cultural value of salmon is sustained by tribes presently living in the Olympic Peninsula region, as evidenced by "First Salmon Ceremonies" conducted upon return of initial salmon runs each year. The cultural importance of

the harvest of salmon by Treaty Tribes was affirmed through Federal Court decisions (e.g., *United States* v. *Washington*, 1974).

In 2000, the U.S. Census Bureau estimated that 3,290 people of American Indian or Alaskan Native heritage (5.1% of the estimated total population of 64,525) resided in Clallam County (U.S. Census Bureau 2002; Figure 1). The reestablishment of ceremonial, subsistence, and commercial fisheries that historically occurred for Ozette Lake sockeye salmon remains important to tribal communities on the Washington Coast, including the Makah Tribe. Commercial sockeye salmon harvests in the region ceased in 1974, and no other Tribal fisheries have occurred within the Ozette Lake sockeye salmon ESU since 1982. One objective included in the HGMP by the Makah Tribe is the fulfillment of Treaty rights through reestablishment of Tribal fisheries, after sockeye salmon recovery and de-listing (MFM 2000).

Land in the Ozette Lake Basin is also important to the Makah Tribe due to the historical presence of a village on the Ozette Reservation. The village was inundated several centuries ago by a mud slide, preserving archeological information regarding Tribal culture that is unavailable elsewhere. The Ozette village site has been excavated by archeologists and has yielded numerous artifacts that form a focal point for the enhancement of Tribal and non-Indian cultural knowledge and experience in the region.

Salmon also provide important cultural and aesthetic benefits to non-Indian communities. Much of the Ozette Lake sockeye salmon ESU lies within Olympic National Park. A small amount of Ozette Lake shoreline property is owned by private interests. The opportunity for non-consumptive observation of spawning salmon, and the existence value of the species are important cultural aspects for lakeshore residents, and visitors to the Park.

3.3.2 Recreational Environment

Tourism, hiking, and sight-seeing in Olympic National Park, including the Ozette River and Ozette Lake, are important recreational pursuits. Dlugokenski *et al.* (1981) reported that in the early 1980s, 60,000 tourists per year visited the western reach of Olympic National Park where Ozette Lake is located. Most visitors come to the park from July through September; December and January are the quietest months. About 95% of the park is designated wilderness. Boating is a popular activity on Ozette Lake. These pursuits are enhanced by the presence and observation of fish and wildlife, including spawning salmon.

Seasonal recreational fisheries for unlisted salmonid species managed by the National Park Service and WDFW occur in Ozette Lake, in some of its tributaries, and in marine waters adjacent to the ESU. Freshwater fisheries target trout and warm-water fish species. WDFW-managed fisheries in the ocean are directed mainly at hatchery-origin chinook salmon and coho salmon destined for other regions. Sockeye salmon and kokanee are currently protected through fisheries regulations that restrict their harvest in these areas.

3.3.3 Economic Environment

Land use in the Ozette Lake watershed where the HGMP would be implemented is devoted mainly to timber production, and forestry practices are the main economic activity in the action area. Private timber companies own the majority of the Ozette Lake watershed. Forestry practices in the watershed are regulated by the Washington State Department of National Resources through the Forest Practice Rules, and by WDFW through the Hydraulic Code of Washington State. From March 1997 to October 1998, 47 forest practice applications were submitted by private timber companies to harvest 1,635 acres of timber along 11 miles of fish-bearing streams in the Basin (MFM 2000). The applications included construction of 16.5 miles of new roads in the watershed.

As mentioned above, rural residential housing and real estate development are additional land uses for private interests on the Ozette Lake shoreline. The National Park Service maintains a headquarters site on the northern shore of Ozette Lake adjacent to the Ozette River. Visitor services, including campgrounds, boat-launching facilities, and Park interpretive displays, are provided at this location. The National Park Service also contracts with private entities to operate concessions within the headquarters location that are widely used by visitors.

No towns supporting services to residents, tourists, and forestry-related companies are present in the HGMP action area. There is one Tribal reservation within the area (the Makah Tribe's Ozette Indian Reservation), but it is uninhabited, and does not provide any economic services. The Ozette Reservation encompasses the location of an historically important fishing and whaling settlement of the Makah Tribe, and comprises 800 acres located north-westward of the lake. The action area is served by rural roads that provide access to Olympic National Park from small Olympic Peninsula towns, including Sekiu, Clallam Bay, and Neah Bay.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Alternative 1 (No Action)

Alternative 1 is NMFS' determination that the HGMP does not adequately address the ESA 4(d) Rule Limit 6 criteria. Under this alternative, the HGMP would not qualify for limitations of section 9(a) take prohibitions. It is expected that the likely outcome of the application of this alternative is that the co-managers would curtail the proposed artificial propagation and research and monitoring and evaluation programs.

4.1.1 Effects on the Physical Environment

Effects on the physical environment resulting from the artificial propagation portion of the RMP are not expected to vary substantially between the No Action and Proposed Action alternatives. Most of the effects of hatchery-related activities proposed through the RMP on the physical

environment are confined to on-going actions at existing salmon rearing facilities in the region. Other effects on the physical environment that may result from placement and operation of a temporary weir and trap, and seines, needed to collect sockeye broodstock (e.g., streambed perturbation, riparian area impacts, stream- and lake-bed sedimentation) are practically imperceptible, and also unlikely to differ between the alternatives.

Curtailment of the artificial propagation portion of the RMP would likely lead to the return of fewer (an estimated 1,200 less (NMFS 2001c)) sockeye salmon adults to the Basin each year. A reduction in the number of returning adult fish would decrease contribution of ocean-derived nutrients to the Ozette Lake system afforded by spawning and dying anadromous salmonids. Water quality and productivity conditions in the Basin may therefore be affected by this reduction of available nutrients. Fewer adult sockeye salmon would also return to tributary spawning areas. The potential for physical changes in stream-bed gravel characteristics, through cleaning and coarsening of spawning gravel by spawning salmon in the heavily sedimented tributaries, would be reduced.

No measurable effects on forest lands in the Basin resulting from implementation of this alternative are likely. With the exception of organic and inorganic matter input resulting from forest practices occurring within the watershed, anthropogenic influences on water quality in the Basin are expected to be negligible. Curtailment of the proposed artificial propagation program may lead to reduced input of nutrients in Basin tributaries by salmon carcasses, which may reduce the amount of nutrients available for the growth of riparian, and perhaps upland, vegetation to an unknown extent.

Effects on the physical environment resulting from research and monitoring and evaluation activities proposed in the RMP are also not expected to be large. All of these activities rely on temporary structures, emplaced seasonally, or on low impact methods, such as seasonal foot or boat surveys. Effects on stream-beds, stream banks, riparian areas, lake environment and timberlands that may result from research and monitoring and evaluation activities, including radio tagging studies, spawning ground surveys, placement and operation of temporary weirs and trapping structures to enumerate smolts and adult fish, and habitat assessment surveys are likely negligible. Few, if any, measurable effects on physical habitat are expected.

4.1.2 Effects on the Biological Environment

Under the No Action alternative, it is assumed that the lack of ESA section 4(d) coverage for the programs would cause the Makah Tribe and WDFW to terminate the sockeye salmon programs described in the HGMP. Termination of the tributary hatchery programs could lead to a reduction of over 1,200 adult fish returning each year to Ozette Lake (NMFS 2001c). The effect of the termination of the hatchery programs would be to decrease the number of naturally spawning fish in the region. Given that the progeny of naturally spawning hatchery-origin fish are listed, the abundance of listed sockeye within the ESU would also likely decrease under this alternative

relative to the Proposed Action. Termination of the programs would also diminish the likelihood for the establishment of sockeye salmon populations in Ozette Lake tributaries that may have once been used by sockeye salmon. The listed sockeye salmon population using lake spawning areas has been low in abundance, and confined to two beach-spawning sites in Ozette Lake. Sockeye salmon adults produced in the lake will be imprinted to beaches where they were spawned, and they are unlikely to stray into tributary areas amenable to sockeye production at levels sufficient to foster establishment of self-sustaining returns. The likelihood for production of additional, listed natural-origin sockeye salmon in the Basin through production in Ozette Lake tributaries would become low under the No Action alternative. The population abundance trend for natural and hatchery-origin adult sockeye salmon returning to available spawning habitat in the Ozette Lake watershed would be expected to decrease from recent year levels as a result of the curtailment of the tributary hatchery program.

If the artificial propagation program is terminated, there would be no potential for adverse demographic, genetic, and ecological effects on the listed lake-spawning sockeye salmon population resulting from sockeye salmon hatchery activities. Under the Proposed Action alternative, these risks to listed sockeye exist, but the proposed HGMP limits actual adverse effects on the listed sockeye salmon population (NMFS 2001c). Under the No Action alternative, anthropogenic risks to listed Ozette Lake sockeye salmon would be confined to those resulting from habitat loss and degradation as a result of on-going forest practices, road construction/maintenance, and, potentially, rural housing development in the Ozette Lake Basin.

Other aquatic and terrestrial species described in the Affected Environment section that inhabit the Ozette Lake Basin and adjacent marine areas would not receive nutrient benefits from the production of sockeye salmon juveniles, adults, and carcasses that would be provided if the HGMP were implemented. A reduction in adverse ecological and demographic effects to those native and introduced fish species competing with hatchery-origin sockeye for food and space might result from termination of the tributary sockeye salmon hatchery programs. Predator species, including marine mammals, river otters, piscivorous fish, and fish-eating birds would lose nutrient benefits accrued through their consumption of hatchery sockeye salmon adults and juveniles. These species would likely continue to consume natural-origin sockeye salmon juveniles and adults, or would transition to predation on other fish species. The relative effects of this predation on the natural-origin sockeye salmon population may increase due to the lack of hatchery-origin fish. This may occur because predation on the natural-origin population may be dampened by availability of the hatchery-origin fish as an alternative prey source (USFWS 1994).

If the co-managers terminate proposed research and monitoring and evaluation activities included in the RMP due to a lack of 4(d) Rule take prohibition limits, the only on-going and planned programs for the collection of data regarding listed sockeye salmon life history characteristics, migrational behavior, annual adult and emigrating juvenile population status, and limiting factors to sockeye salmon survival and productivity would be lost. Currently available information regarding life history, stock status, and limiting factor issues is insufficient. There are no other entities collecting any additional scientific information regarding Ozette Lake sockeye salmon that

is designed to be beneficial to the listed population's recovery. Processes for planning listed sockeye salmon recovery as mandated under the ESA (including NMFS' Puget Sound/Washington Coastal Technical Recovery Team and "Shared Strategy" initiatives) would be left without critical information needed to appropriately direct decision-making processes. As a result, prospects for understanding critical life history traits, identifying factors responsible for the decline of the population, and recovering the listed population through implementation of appropriate management actions, would be substantially diminished.

In summary, it is likely under the No Action alternative that prospects for the recovery of the Ozette Lake sockeye salmon ESU would diminish relative to prospects afforded through the Proposed Action. The abundance of listed, natural-origin sockeye salmon would be reduced if the artificial propagation portion of the RMP were not implemented. Absent improvements in lake spawning sockeye productivity, and in past and present land-use practices that have likely diminished their survival, the listed population would likely remain at depressed abundance levels for the foreseeable future. Curtailment of the research, monitoring and evaluation portion of the RMP would decrease prospects for understanding the biological processes responsible for the decline of the ESU, and implementation of effective management measures needed for its recovery.

4.1.3 Effects on the Cultural, Recreational, and Economic Environment

Effects on the cultural, recreational, and economic environment under the No Action alternative may include reductions in cultural and economic benefits to Indian and non-Indian interests in the region as an artifact of continued, reduced sockeye salmon abundance. Sockeye salmon adult return numbers to Ozette Lake tributaries would not be increased, and prospects for the near term recovery, and the likelihood for delisting of naturally spawning sockeye salmon now protected under the ESA, would likely be diminished for the foreseeable future. The likelihood that sockeye salmon would be available for harvest in treaty-reserved Tribal ceremonial and subsistence and commercial fisheries, and in non-Indian recreational fisheries, would decrease in the short and long term. Cultural benefits to the Makah Tribe afforded by the allowance for Tribal ceremonial and subsistence fishing, which has been curtailed since 1982, would not be realized for the foreseeable future under the No Action alternative.

On-going closures of regional fisheries as measures to protect listed sockeye salmon would mean that economic benefits to the local area attendant with fisheries openings would continue to be limited. With less fishing opportunity, the region's economy would not benefit to the extent that it could from retail sales and jobs provided through fish sales and processing; the purchase of boats, boat repair services, equipment and fuel; and food and lodging sales at motels and restaurants. The number of people visiting the region for recreational fishing purposes, and spending money in the local area, would also be expected to be less, relative to the Proposed Action outcome. However, NMFS would continue to work with affected Indian Tribes to protect their Federally-reserved fishing rights, which may partially mitigate adverse cultural and economic

effects on the Tribes resulting from needed fisheries closures, even without HGMP implementation.

Continued low sockeye salmon abundances in the Ozette Lake Basin may also adversely affect non-consumptive recreational enjoyment and use in the region. Decreased salmon viewing opportunities resulting from fewer returning adult fish may decrease, to an unknown extent, the number of tourists visiting the region, and local economic benefits attached with tourism as a consequence.

Termination of HGMP actions could also lead to adverse effects on other aspects of the human environment. The duration of time that the Ozette Lake sockeye salmon population is listed under the ESA would likely be extended without the production of additional naturally spawning sockeye salmon in the tributaries, and collection of stock status, life history, and limiting factors information proposed under the HGMP. Human activities affecting sockeye salmon, including recreational and economic pursuits in the Ozette Lake Basin, would continue to be limited commensurate with the need to protect the fish under Federal ESA requirements as long as the fish are listed. These activities would likely be limited for a longer duration under the No Action alternative.

4.2 Alternative 2 (Proposed Action)

4.2.1 Effects on the Physical Environment

Effects on the physical environment that would result from implementation of the HGMP are not expected to vary substantially between the No Action and Proposed Action alternatives. Most of the effects of the activities proposed in the HGMP on the physical environment would be confined to on-going actions at existing sites in the region, including hatcheries and fish collection weirs. Other effects on the physical environment resulting from "new" actions implemented through the HGMPs would be temporary, and likely to be imperceptible. Possible impacts to the stream-beds, riparian vegetation, and habitat might occur primarily as a result of limited duration adult sockeye salmon abundance surveys, fish tagging, broodstock collections, and salmon smolt-trapping activities. These actions include: weir placement, operation, and removal, and in-river fish collection activities (trapping ans seining, mainly in Umbrella Creek and in the Ozette River); and hatchery water withdrawal and effluent discharge. However, the HGMP already includes measures designed to minimize these impacts, such as the use of temporary weir structures, and compliance with existing, protective water withdrawal and effluent discharge permits.

Construction activities directly related to implementation of the HGMP would be limited to temporary weir and trap placement and removal. These activities are not expected to result in large impacts to riparian habitats because of the temporary, transportable design of the structures, and installation and removal procedures applied under the HGMP. Again, most of the facilities used in association with the HGMP are already in place. If the HGMP is terminated, some access points to the freshwater reaches where the weirs, traps, and hatcheries are located might

experience a reduction in traffic, but in most cases would continue to be used for other river activities, such as salmon spawner census surveys. In these aspects, implementation of the HGMP would have a negligible impact on the physical environment.

Two of the four hatchery sites used to produce sockeye salmon juveniles would be located within habitat important for listed sockeye salmon. Water quality at these two locations (Umbrella Creek and Big River) may potentially be affected as a result of water withdrawal practices or hatchery effluent releases into receiving waters. The hatchery programs in these watersheds would be very modest in size, and would not involve consumptive use of surface water or groundwater. The total biomass of sockeye juveniles produced each year at either hatchery location would not exceed 400 pounds. The EPA assumes elevated risks of water quality impacts, and therefore requires a National Pollutant Discharge Elimination System (NPDES) permit, only for hatcheries that release more than 20,000 pounds of fish annually. The proposed hatchery programs would maintain 400 pound per year maximum fish production levels that are well under this annual production standard established by the EPA, and no NPDES permits are required. Small amounts of uneaten fish food and metabolic wastes from reared sockeye salmon would be sufficiently diluted by the flow in receiving waters. Addition of total suspended solids, metabolites, and associated nutrients from the sockeye salmon hatchery operations would not be expected to significantly alter the chemical, biological, or physical properties of Umbrella Creek, Big River, or Ozette Lake.

The hatchery programs would be operated to comply with Washington State water right and water withdrawal permits, Washington State water quality criteria, and Federal effluent discharge limits for freshwater hatcheries. Compliance with these guidelines and permits is expected to adequately limit the risk of adverse effects to downstream aquatic life and critical habitat for listed fish.

An alternate effect on water quality is related to the presence of salmonid carcasses in the water, as a result of dying after spawning, or dying during unsuccessful upstream migration. Enhanced numbers of sockeye salmon adults returning to spawn as a result of the HGMP, and the practice of returning spawned carcasses used as hatchery broodstock back to the streams, would likely be beneficial to the ecosystem by increasing ocean-origin nutrients available in the Basin for use by aquatic and terrestrial organisms (Cederholm *et al.* 2000).

4.2.2 Effects on the Biological Environment

Potential Impacts to Listed Sockeye Salmon

The potential effects of the proposed HGMP on listed Ozette Lake sockeye salmon are described and evaluated in the NMFS 4(d) Rule draft evaluation and recommended determination document prepared for the program (NMFS 2001c). Findings included in that document are summarized below.

The abundance of naturally spawning sockeye salmon is likely to increase through implementation of the HGMP, increasing the abundance of resultant listed natural-origin sockeye, the spatial distribution of sockeye within the ESU, and perhaps the genetic diversity of sockeye salmon comprising the ESU. Applying an estimated fry to returning adult survival rate of 0.6% (MFM 2000) to the total number of sockeye salmon juveniles proposed for release through the HGMP, beginning in 2004, 480 "F1" adult sockeye would return to Umbrella Creek and 798 "F1" adults would return to Big River each year. Approximately 1,200 adults are therefore projected to return each year as a direct result of the HGMP programs. Assuming that the majority of these fish escape to spawn naturally, and that spawning adults are successful in replacing themselves (applying a conservative 1.0 recruit per spawner ratio), substantial improvements in the abundance status of the listed natural-origin sockeye salmon may accrue.

Additional natural-origin recruit adult fish would return to the tributaries concurrently with the first generation hatchery-origin adult sockeye salmon. Prior to initiation of the Makah Tribal hatchery program, sockeye salmon had not been observed spawning in Umbrella Creek for many decades. Naturally spawning returns to the Ozette Lake tributaries (specifically Umbrella Creek) resulting from the hatchery juvenile sockeye releases are assisting in the creation of natural-origin recruits. Of the 138 sockeye salmon spawners per mile observed in Umbrella Creek in 1999, the Makah Tribe estimates that 37.2% were natural-origin recruits, yielding an estimated adult replacement rate for natural spawners of 2.7 (MFM 2000). Although evidenced by only one year of data, natural-origin recruit returns may indicate that life history traits of the original donor, lake-spawning sockeye stocks are compatible with, and may have adapted to, Ozette Lake tributary habitat conditions. Based on available tributary spawning habitat, the abundance of listed fish in the ESU should increase if self-sustaining populations are established at full habitat seeding levels in the tributaries as a result of the proposed hatchery program. Results for 1999 indicate that natural-origin recruit tributary spawners established through the hatchery program have the potential to become self-sustaining.

Determinations of whether self-sustaining sockeye aggregations have been successfully established in the tributaries must rely on stock recruitment data collected as described in the HGMP over several sockeye generations. Furthermore, recovery of self-sustaining, natural-origin returns is dependent upon their continued productivity in the natural environment. Meaningful, commensurate improvements in the condition of habitat needed to sustain sockeye salmon in the Ozette Lake Basin are required for natural-origin sockeye salmon aggregations to return to self-sustaining, viable statuses. This situation applies under the No Action alternative for the listed beach spawning population, and under the Proposed Action alternative for both the beach spawning and introduced tributary spawning populations.

The listed beach-spawning population that is the focus of the NMFS ESA listing decision would not be directly enhanced as a result of the HGMP. The beach-spawning population would also not be affected by broodstock collection proposed through the HGMP for the tributary hatchery program. For these instances, demographic effects on the listed beach-spawning sockeye salmon population would not differ between the Proposed Action and No Action alternatives. However,

by producing natural-origin recruit adult returns to Basin tributaries in excess of current beach spawning population levels, implementation of the HGMP is expected to produce a stable or increasing trend in escapement and abundance until extant populations for recovery (including the standing of natural-origin recruit tributary sockeye in recovery considerations), and a viable abundance threshold for the Ozette Lake sockeye salmon ESU, are identified (one task of the Puget Sound/Washington Coastal TRT). HGMP-implemented research of limiting factors affecting the lake spawning population, and identification of habitat restoration strategies based on research findings, would benefit initiatives for listed ESU recovery. In these respects, the Proposed Alternative differs from the No Action alternative, which would not increase natural-origin sockeye abundance and distribution, or lead to the collection of needed research data.

The tributary sockeye salmon aggregation propagated under the HGMP is part of the Ozette Lake sockeye salmon ESU, as it was derived from the beach-spawning population that is of core concern regarding recovery of the ESU. As stated in the Federal Register Notice announcing the ESA listing of Ozette Lake sockeye, the hatchery population is not essential for recovery, but if conditions warrant, the stock is not precluded from playing a role in recovery (64 FR 14528, March 25, 1999). The listing decision established the legal status of the existing hatchery population only, and does not preclude use of aggregations created through hatchery supplementation as essential parts of future, formal Ozette Lake sockeye salmon ESU recovery efforts. Pending TRT sockeye salmon recovery determinations, establishment of sockeye salmon populations in the tributaries may be considered a genetic reserve for the listed stock. Sockeye salmon returns established through the hatchery program in the tributaries originated from the listed beach spawning population, and are only one generation removed (for use in artificial propagation) from that population. By spreading sockeye production to an alternative spawning area within the Basin, establishment and maintenance of tributary aggregations decreases the risk that Ozette Lake sockeye salmon would be lost due to natural or man-caused catastrophic events affecting the beach-spawning sockeye salmon population or the productivity of the beach environment. However, regardless of the ESA standing of tributary sockeye aggregations established through the HGMP, recovery of the ESU would still require restoration of a self-sustaining, viable beach spawning sockeye salmon population.

The HGMP includes comprehensive monitoring and evaluation and research components (see page 11). In the period prior to TRT determinations, these monitoring and evaluation and research activities would help identify the abundance status of the listed sockeye salmon population with a higher degree of confidence. These activities would also greatly improve scientific understanding of factors that have contributed to the decline of the lake population, and factors presently limiting or threatening beach spawner abundance.

The hatchery program described in the HGMP has a potential to adversely affect natural-origin beach-spawning sockeye salmon through demographic, ecological, and genetic effects. For example, ecological effects on natural-origin fish may potentially occur through food resource competition in Ozette Lake resulting from interactions with juvenile hatchery sockeye salmon. Genetic impacts may potentially be imparted through tributary hatchery-origin sockeye salmon

adult straying to beach spawning areas where they may interbreed with natural-origin fish. To reduce the potential for adverse effects to listed natural-origin sockeye salmon, risk minimization measures are described in the HGMP.

Measures applied to minimize the risk of adverse effects on listed natural-origin sockeye salmon are also described in the NMFS 4(d) Rule evaluation and recommended determination document (NMFS 2001c). Demographic risk minimization measures include limits on the location of broodstock collection operations (tributaries only), and on the number of adults removed from beach areas for research purposes (10 fish), to limit collection and removal effects on natural beach-spawning sockeye salmon.

The risk of food resource competition with beach-origin sockeye salmon juveniles would be minimized by restricting total hatchery fry (1.2 gram fish size) release numbers to 213,000 fish. The sum of this planned annual hatchery fry release level and the estimated annual natural-origin sockeye salmon fry production in Ozette Lake (460,450 fry total) would be well below the 800,000 annual *O. nerka* fry production level assumed by Beauchamp *et al.* (1995) in a study that found that food resources were not limiting sockeye salmon juvenile productivity. Beauchamp *et al.* (1995) concluded that food supply in Ozette Lake is unlikely to limit even large sockeye salmon enhancement efforts, defined as a 10 to 50-fold increase in annual fry production above the 800,000 production level. The risk of fish disease transmission from hatchery fish to listed natural-origin sockeye salmon is minimized through hatchery program compliance with "Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" (NWIFC and WDFW 1998) and Pacific Northwest Fish Health Protection Committee (PNFHPC 1989) protocols. These protocols define incubation, rearing, sanitation, and fish health practices that minimize the potential for disease transmission, both within and outside of hatchery stocks.

Genetic diversity preservation methods applied under the HGMP, including a 12 year limit on the duration of the tributary hatchery programs, application of factorial mating protocols, low intervention hatchery rearing methods, and the limited duration of hatchery fish rearing (60 to 90 days) would minimize the risk of adverse genetic effects to sockeye salmon propagated in the hatcheries, including risks of within population diversity reduction and domestication. The risk of tributary hatchery-origin sockeye salmon straying to non-target beach-spawning sockeye areas would be minimized by imprinting the fish to the target watershed via on-station rearing.

The risk of sockeye salmon hybridization with kokanee salmon may potentially be increased through implementation of the HGMP. The production of tributary-spawning sockeye salmon may lead to interbreeding with kokanee returning to spawn in the tributaries at the same time as the sockeye. To address this concern, the tributary hatchery programs proposed in the HGMP would be limited to streams with very few kokanee salmon. Ozette Lake tributaries were surveyed in 1999 by the Makah Tribe to identify kokanee spawner abundance and suitable sockeye spawning habitat. Through the surveys, Big River and Umbrella Creek were identified as suitable hatchery sockeye release locations because both had good sockeye habitat and very small spawning populations of kokanee. Under the proposed HGMP, the tributary hatchery programs

are confined to Umbrella Creek and Big River. The risk of sockeye and kokanee interbreeding is reduced by this measure. A genetic monitoring program is implemented through the HGMP to determine if sockeye and kokanee hybridization occurs as a result of the tributary hatchery programs.

Under the Proposed Action alternative, demographic, ecological, and genetic risks to listed sockeye salmon would be present to a greater degree relative to the No Action alternative. However, the proposed HGMP adequately limits the likelihood for substantial effects on the listed sockeye population through its modest fry production scale, and through implementation of risk minimization actions (NMFS 2001c).

Potential Impacts to Unlisted Salmonids

Kokanee salmon

As noted previously, implementation of the HGMP carries a slight risk that hybridization between sockeye and kokanee would increase. Research has indicated that Ozette Lake sockeye and kokanee are evolutionarily-divergent (Gustafson *et al.* 1997), and studies have indicated that hybrids of the two races may have reduced fitness. Introgression among these highly distinct gene pools could reduce the fitness of both populations in Ozette Lake. These concerns have been considered in developing the HGMP (MFM 2000). Efforts are underway to genetically characterize *O. nerka* spawning aggregations in the Ozette Lake Basin and to determine a baseline level of hybridization (see proposed research, monitoring and evaluation on page 11).

Hybridization in tributaries to Ozette Lake is a concern because kokanee are known to utilize some tributaries in high numbers. Again, the HGMP proposes tributary hatchery sockeye releases only into Umbrella Creek and Big River, which are both known to have very low numbers of kokanee. Adult hatchery-origin sockeye stray rates to areas other than their release location have been near zero (MFM 2000), which further reduces the risk of loss of fitness from potential hybridization. Kokanee-sockeye interactions would be monitored through spawner surveys and genetic analyses. If substantial hybridization is detected due to any supplementation strategy, the strategy would be changed or discontinued.

Kokanee are known to be susceptible to infectious hematopoietic necrosis virus and bacterial kidney disease infections. However, transmission of pathogens responsible for these diseases as a result of hatchery-origin sockeye salmon releases is unlikely. Evidence does not indicate routine disease transmission from hatchery to wild fish (Steward and Bjornn 1990). The incidence of infectious fish pathogens would be monitored in sockeye fry up through each release. Pathogen incidence in kokanee and in hatchery sockeye post-release, would be evaluated when disease signs are observed and when samples can be collected, to determine the potential for disease transmission among these species.

Despite the dietary overlap between juvenile kokanee and sockeye, it is unlikely that food availability is a limiting factor on *O. nerka* production in the Ozette Lake Basin, as previously described.

Coho salmon

Increased sockeye salmon abundance in Ozette Lake resulting from hatchery releases is not expected to result in adverse ecological effects on coho salmon. Lake-rearing coho salmon juveniles could benefit by preying on the increased number of juvenile sockeye fry in tributaries and littoral areas, primarily in the spring (Ruggerone 1989). Increased sockeye carcass deposition resulting from hatchery adult returns would be expected to increase nutrients available to the food web in tributaries as well, to the benefit of coho salmon productivity.

Although evidence does not indicate routine disease transmission from hatchery to wild fish (Steward and Bjornn 1990), there is a slight risk that fish pathogens could be harbored by hatchery-origin sockeye salmon and be transmitted to coho salmon. The incidence of infectious fish pathogens in juvenile sockeye salmon at the time of their release would be evaluated to determine the potential for transmission of pathogens to coho salmon.

Competition for spawning areas between adult sockeye and coho, or redd superimposition by sockeye, could occur in Ozette Lake tributaries, to the detriment of coho salmon productivity, as sockeye salmon returns increase. However, limits to coho productivity are expected to be primarily associated with rearing space and food availability for juveniles. These factors should not be affected by sockeye salmon, which inhabit a different niche in the lake ecosystem. In addition, adult coho salmon typically target different stream habitat types than sockeye salmon for spawning.

To address concerns over potential spawning competition among coho and hatchery-origin sockeye, the distribution of both species would be monitored under the HGMP through spawner surveys in Ozette Lake tributaries. The HGMP advocates removal of adult sockeye salmon for use as broodstock from spawning areas based upon in-depth examinations of channel-specific, habitat, and density-dependent spawner analyses in tributaries (MFM 2000). These examinations would further identify habitat subtypes utilized by sockeye and coho salmon, and would identify the number of coho and sockeye salmon spawners per mile, redd superimposition levels, and relative survival and productivity measured between and within specific stream segments.

Cutthroat Trout, Rainbow Trout, and Steelhead

Increases in sockeye salmon abundance resulting from HGMP fish releases are not expected to have negative ecological implications for cutthroat trout, rainbow trout or steelhead survival and productivity. Adult cutthroat and juvenile rainbow trout and steelhead may benefit to some extent by preying on the increased number of juvenile sockeye (e.g., Beauchamp 1995). The potential for disease transmission from hatchery-origin sockeye to these species is considered to be very low. Although the discharge of hatchery effluent, and interactions between supplemental sockeye and cutthroat have the potential to transmit fish pathogens, there are no documented cases of disease transmission from sockeye salmon to cutthroat trout. However, the incidence of infectious fish pathogens in sockeye salmon juveniles at the time of their release would be evaluated to avoid the potential for transmission of pathogens to cutthroat trout.

Potential Impacts to Non-Salmonid Fish Species

Adverse impacts on non-salmonid fish species resulting from the HGMP are unlikely. Sockeye salmon juveniles produced through the HGMP are likely to serve as prey species for other fish in freshwater and marine areas within the region, and any effects of the programs on these species are likely beneficial. Similarly, adult sockeye salmon produced by the tributary hatchery program would provide nutrient benefits to the Ozette Lake Basin ecosystem through additional salmon carcasses decomposing in the tributaries after the fish have spawned. Increased productivity of food resources used by other fish species should benefit their growth and survival.

No negative impacts on northern pikeminnow or largemouth bass populations are expected. Both species are known to prey on juvenile salmon. Increased juvenile sockeye salmon production afforded by the hatchery programs is likely to provide a food source for these species, potentially buffering predation on naturally-produced juvenile sockeye salmon. Increased monitoring as proposed under the HGMP would provide additional information on piscivorous fish predation rates at the Ozette Lake outlet that would not be available under the No Action alternative.

Redside shiners, stickleback, and juvenile yellow perch are planktivorous fish species, which suggests the potential for interspecies competition with juvenile sockeye salmon. Zooplankton abundance is not currently believed to limit the productivity of any species in the lake (e.g., Beauchamp *et al.* (1995) findings), so no negative ecological impacts on these species are anticipated.

No negative impacts on peamouth, prickly sculpins or Olympic mudminnows would be likely to result from ecological interactions with sockeye salmon produced under the HGMP. Sculpin are known to consume sockeye salmon eggs and fry, and prickly sculpins may benefit nutritionally from increased sockeye abundance resulting from hatchery production under the HGMP. Peamouth and Olympic mudminnows are opportunistic and, mainly, benthic feeders. Diet overlap and competition with hatchery sockeye salmon juveniles in Ozette Lake are therefore unlikely. Spawning aggregations of peamouth in Umbrella Creek may lead to short term competition effects posed by co-occurring, emigrating hatchery-origin sockeye salmon fry. These effects would be transitory and limited each year to a few week period when the juvenile sockeye salmon exit the tributary for lake rearing areas.

Potential Effects on Other Living Resources

The increased abundance of returning adult sockeye salmon that would result from implementation of the HGMP would likely benefit local marine and terrestrial predator and scavenger populations. In particular, harbor seals, sea lions, and river otters prey on returning sockeye salmon adults in the Ozette River, Ozette Lake, and in marine waters adjacent to the Ozette River mouth. Bald eagles and gulls would likely benefit from enhanced sockeye salmon spawner numbers created in the tributaries by the hatchery programs through consumption of live and/or decomposing (post-spawning) fish in the streams and estuary. Juvenile sockeye salmon releases into the tributaries would likely provide benefits to other piscivorous bird species that feed on the juvenile fish in Ozette Lake and in the Ozette River.

Other organisms in the Ozette Lake ecosystem that depend on salmon carcasses as a nutrient source, including crayfish, aquatic invertebrates, and juvenile salmonids, may also benefit from the enhanced numbers of salmon carcasses that would be provided by spawning adult fish returns from the HGMP hatchery programs. These additional carcasses would not be made available to these organisms as a nutrient source under the No Action alternative.

4.2.3 Effects on the Cultural, Recreational, and Economic Environment

This alternative would likely result in beneficial effects on the social, economic, and cultural aspects of the human environment. Increased annual abundances of adult sockeye salmon resulting from HGMP tributary hatchery programs are expected to improve future prospects for recovering the population to a level that would sustain harvest to meet Tribal cultural needs, including eventual resumption of ceremonial and subsistence fisheries. Increased numbers of sockeye salmon spawners would also provide aesthetic benefits to non-Indian visitors to Olympic National Park by increasing viewing opportunities for fish, and terrestrial organisms dependent on fish.

Unlike under the No Action alternative, the aesthetic value of those natural areas in Olympic National Park near adult and juvenile sockeye trapping locations may be adversely affected under the Proposed Action. However, the weir and trap structures would be temporary and removable, and operated seasonally (spring through mid-summer). Also, the major trapping sites are located beneath and just downstream of existing, permanent structures. The adult weir and smolt trap are located below a concrete and wooden foot bridge constructed and maintained by Olympic National Park that spans the Ozette River at its confluence with Ozette Lake. The adult floating weir and trap are located below an existing concrete highway overpass spanning Umbrella Creek at approximately river mile 1. Adverse aesthetic effects as a result of the placement and operation of the trap structures are therefore expected to be negligible.

Ecosystem benefits afforded by the HGMPs through increased returns of adult sockeye salmon may have important local and regional economic benefits. Salmon in abundance are generally viewed by the public as indicative of a healthy ecosystem. Also, natural and hatchery-origin fish produced through the HGMP would recycle ocean-derived nutrients to local freshwater ecosystems upon dying, benefitting terrestrial and aquatic plant and other animal life valued by humans. The existence, and aesthetic appeal, of healthy ecosystems within the same region where major Northwest cities are located is attractive to people and businesses for life style and quality of life reasons. The healthy environment fostered by abundant salmon returns may therefore help to attract tourism and outdoor recreational sportsmen to the local area. High technology and other industries may be attracted to locate in the region to take advantage of the nearby, high quality environment, potentially improving the economic condition of western Washington communities.

Increases in sockeye salmon adult returns resulting from the tributary hatchery program may highlight the need for commensurate changes in land use practices in the Ozette Lake watershed

to recover listed sockeye salmon. Land use on private and State-owned lands in the watershed is principally devoted to forest practices. Outside of that portion of the Ozette Lake Basin that is included in the Olympic National Park, virtually the entire watershed has been logged over the last 50 years. Among the changes attributable to past forest practices (including intensive logging, wood removal in Ozette Lake tributaries, and associated road building in the watershed prior to State regulation of forest practices) is degradation through siltation of streams, tributary outwash fans, and beach areas historically used by sockeye salmon. Several initiatives are currently in process or being proposed to address the effects of land use activities on listed fish species, including Ozette Lake sockeye salmon. For example, the Forest and Fish Report is an effort by the State of Washington to implement changes in forest management activities that are intended to provide additional protections to listed salmonids (65 FR 42422, July 10, 2000).

Historically, non-Indian recreational fisheries and commercial salmon fisheries by the Treaty Tribes have also been economically important in the Ozette Lake Basin. Economic benefits to the region from these fisheries include: revenue generated through fish sales; jobs provided through commercial fishing and fish processing as occupations; purchase of boats, boat repair services, equipment and fuel from local businesses; and the purchase of food and lodging at local motels and restaurants. However, the current, ESA-listing status of Ozette lake sockeye salmon limits the ability of the region to fully benefit from salmon fisheries by limiting the opportunity to harvest surplus unlisted salmon intermingled with listed sockeye salmon in traditional harvest areas. Improvements in the prospects for recovery of the listed sockeye salmon through HGMP hatchery, research and monitoring and evaluation activities, and complementary habitat and harvest management actions, are needed before State and Tribal fisheries can fully benefit from, and in some cases resume, regional salmon fisheries.

Implementation of the HGMP is expected to help improve prospects for the future resumption of fisheries relative to the No Action alternative. Under the Proposed Action alternative, the total annual number of returning natural- and hatchery-origin adult sockeye salmon produced in the Ozette Lake watershed would be expected to increase as a consequence of the tributary hatchery programs. Research and monitoring and evaluation information gathered through programs proposed in the HGMP is expected to improve the likelihood for effective application of management measures addressing human-caused factors for decline of the listed sockeye salmon population. Application of these measures should help protect and increase sockeye abundance and productivity in the Basin. Neither the hatchery programs or the research, monitoring and evaluation programs would be implemented under the No Action alternative. Increases in sockeye salmon abundance and productivity are more likely outcomes under the Proposed Action, potentially leading to timely recovery of the population, and subsequent resumption of conservation-based fisheries when viable, self-sustaining sockeye salmon returns are re-established.

4.2.4 Summary and Cumulative Effects

NMFS' determination that the HGMP addresses the ESA 4(d) Rule Limit 6 criteria would limit application of ESA section 9(a) take prohibitions for the described activities. Increased numbers of adult salmon directly and indirectly produced by the program would help preserve and increase the abundance of listed natural-origin sockeye salmon, and benefit the ecosystem by increasing nutrients (via carcasses and juvenile fish as prey) available to aquatic and terrestrial organisms. If the HGMP is successful in assisting in the recovery and de-listing of sockeye salmon, the availability of sockeye salmon to meet Treaty-affirmed Tribal rights for the harvest of salmon for food and cultural use would be enhanced. In addition, recreational and economic benefits to the Indian and non-Indian communities may accrue through increased fishing opportunities, augmentation of fisheries-related jobs, revenue generated by local service industries as a result of increased tourism, and through the sale of fish and fishing equipment. By providing increases in salmon abundance, this alternative would also maintain public support for salmon recovery efforts.

If habitat and harvest factors outside of the proposed actions are addressed, implementation of the ESA-authorized HGMP should result in benefits to the biological environment, and cultural, economic and aesthetic benefits for Tribal and non-Indian communities located adjacent to the Ozette Lake watershed.

5.0 LIST OF AGENCIES/PERSONS CONSULTED

The following resource management agencies were consulted during preparation of this environmental assessment:

Makah Indian Tribe
Bureau of Indian Affairs
Washington Department of Fish and Wildlife
U.S. Fish and Wildlife Service

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